Stormwater Management Report

125 Pennsylvania Avenue

125 Pennsylvania Avenue

Framingham, Massachusetts

Prepared for **Crossroads Center Acquisitions, LLC**
c/ o The Congress Group
33 Arch Street, Suite 1100
Boston, Massachusetts 02110
(617) 897-7200

Prepared by **Vanasse Hangen Brustlin, Inc.**
Transportation, Land Development, Environmental Services
99 High Street
Boston, Massachusetts 02110
(617) 728-7777

December 17, 2013

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1

Project Summary

The 125 Pennslyvania Avenue project is located at 125, 135, and 137 Pennsylvania Avenue in the town of Framingham (see Figure 1) a 10.03 acre site). The three combined lots contain 10.03 acre of land area. The Site is bounded by Pennsylvania Ave to the north, the Massachusetts Turnpike (Interstate 90) to the south, 115 Pennsylvania Avenue to the west, and 145 Pennsylvania Avenue to the east. The site is currently zoned Technology Park District. The site is presently owned by Framingham CFII, LP. and it is to be redeveloped by The Congress Group.

Under existing conditions, untreated stormwater runoff flows to three separate discharge points via a series of roof drains, chained catch basins, and over land flows as shown on Figure 2. A small amount of roof and paved area from 125 Pennsylvania Avenue discharges to the town system in Pennsylvania Avenue, an undeveloped vegetated slope area discharges to the southeast, and the majority of the site eventually discharges to the southeast corner of the site via an existing swale along the southerly edge of the property line.

The proposed site is designed to create easy accessibility within the development and includes additional green space and a bio-filtration rain garden for increased groundwater recharge. The proposed drainage runoff pattern is shown on Figure 3. Under proposed conditions, the stormwater will be treated by BMPs before being discharged. This will be accomplished by a system of treatments starting with a comprehensive maintenance program, which includes street sweeping, landscape care of the site, and site maintenance**.** Stormwater infrastructure will include rain gardens, deep sump hooded catch basins, and Stormceptor water quality units. Wherever possible, the existing drainage and grading patterns were maintained in the proposed design, and low impact development stormwater management techniques have been incorporated into the site and are described herein.

A HydroCAD model, using TR-20 methodology, was developed to evaluate the existing and proposed drainage conditions on the site. The results of the analyses indicate that there is no increase in peak discharge rates and volume between the pre- and post-development conditions for the 2, 10, and 25, and 100 year storm events. The pre- and post-development peak discharge values are presented in Table 3 at the end of this report.

The Stormwater Management Plan, including Best Management Practices (BMPs) for maintaining stormwater runoff quality both during and after construction, was prepared in accordance with the applicable local, state, and federal regulations. Details of the Plan are provided herein.

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Existing Conditions

Summary

The approximate 10.03 acre project site consisting of three buildings along Pennsylvania Avenue in Framingham, Massachusetts that includes the former location of the International Paper Company. The existing buildings make up 26%, or 2.63 acres, of the total site. Pavement and other impervious areas make up 27% and wooded and grassy areas make up 47% of the site. The majority of the site discharges to a stormwater swale that runs east along the southern property line. The site is bounded by Pennsylvania Avenue to the north and the Massachusetts Turnpike to the south. See Figure 2 for a map showing the existing conditions.

No portion of the project site is located within the 100-year flood plain as shown on the FEMA flood insurance map, Panel 4 of 12, Community Panel number 250193-0004 C, which is included in Appendix B.

The Town of Framingham has a local Wetland Protection By-law designating a 30-foot, "No Disturbance," buffer to wetland resource areas. Based on the project team field delineation, no resource area was identified on site; however, resource areas were field located on the abutting properties where the 125' buffer zone is extended onto the project area.

The soil on-site is identified as Urban Fill based on available boring information and NRSC Soil Survey data. Detailed soils information and map is included in Appendix C.

Hydrologic Information

For the existing conditions hydrologic analysis, the site is divided into three catchment areas eventually discharging to three separate design points. Peak discharge rates were evaluated at these three design points (see Figure 2). The majority of the site indicated as catchment area S1 drains to an existing stormwater swale along the southern edge of the property line and eventually discharges to Design Point 3. The remaining 6.7% of the site discharges to an existing 12-inch storm drain in Pennsylvania Avenue indicated as catchment area S2.

Table 1 summarizes the key hydrologic parameters for each catchment area.

Table 1

Existing Conditions Hydrologic Data

Description (Drainage Area #)	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)*
S1	SE Site	1	7.98	90	9.9
S2	Pennsylvania Ave.	2	0.67	95	3.4
S3	SW Site	3	1.38	79	2.2

* Tc was chosen based on existing drainage patterns (see Figure 2).

3

Proposed Conditions

Summary

The project was designed to comply fully with the Massachusetts Stormwater Management Policy. Existing drainage and grading patterns were maintained to the maximum extent possible. Low impact development stormwater management techniques have been incorporated into the design. These practices are focused at decentralizing stormwater management at the site and incorporating many smaller stormwater management techniques into the design that will reduce peak runoff rates and treatment. The proposed condition shows a small net increase in impervious cover. Stormwater BMPs are incorporated to compensate for the increased runoff rate and volume, as well as water quality. No new untreated discharge locations will be added, and any potential illicit connections will be cut and capped during the demolition phase.

Rain garden, deep sump hooded catch basins and Stormceptor units will provide TSS removal of the sites stormwater with an annual TSS removal rate greater than 80% (see Appendix D). Please refer to Table 3 and 4 for a comparison of stormwater runoff on the pre and post redevelopment conditions.

Water Quantity and Quality Control

Site Layout

Throughout the entirety of the site proposed grades were matched to existing conditions where the site constraints allowed. Rain garden and a surface detention pond has been incorporated for water quality and quantity control. Any potential illicit connections will be removed as part of the demolition and cut and cap process and all proposed drainage will discharge to the existing discharge point located within the site (see Figure 2).

Source Control

A comprehensive source control program will be implemented at the site which includes, quarterly pavement sweeping throughout the site, and catch basin inspection and cleaning. Furthermore the project will include enclosures and maintenances of all dumpsters, compactors, and loading areas. Further discussion of the site maintenance is included in the Stormwater Management Regulations Section 5.

Snow Management

Snow storage areas are shown in Appendix A, Figure 4. Snow will only be placed in designated areas and at no time dumped in or directly adjacent to the resource areas. To the extent possible, snow will be allowed to melt where debris and sand may be deposited and cleaned up for disposal and snow melt then will enter the stormwater management system where it will receive proper treatment.

Spill Prevention

Spill prevention is achieved with the proper storage and handling of hazardous materials. During construction, this will be addressed in the Stormwater Pollution Prevention Plan (SWPPP) for Construction Activities to be prepared and implemented by the Site Contractor. The general response procedures for spills at any time are outlined in Appendix I and are included in the Operation Maintenance Plan.

Catch Basins with Sumps and Oil/debris Traps

Catch basins at the site are to be constructed with sumps (minimum 4-feet) and oil/ debris traps to prevent the discharge of sediments and floating contaminants. Cleaning of catch basins will follow the schedule set forth in Appendix H, Operation and Maintenance Plan.

Water Quality Units

The Project proposes Stormceptor BMP units. The Stormceptor® Water Quality units efficiently remove total suspended solids (TSS) and free oil from the stormwater run-off. The units prevent the re-suspension of settled material and allow for safe and easy removal of collected material. The water quality units will be inspected four times per year and cleaned a minimum of once per year, or when the sediment reaches 8-inches in depth. TSS calculations for the units are provided in Appendix D.

Rain Garden/Surface Detention

The Project proposes a rain garden or bio-filtration facility and a surface detention pond to not only treat and infiltrate roof top and parking lot runoff, but to also reduce the peak discharge rate and quantity of stormwater. TSS calculations for the facilities are provided in Appendix D.

Hydrologic Information

For the proposed conditions hydrologic analysis, the site was divided into 3 sub catchment areas (see Figure 3). These areas discharge to 3 separate design points, where peak discharge rates and quantities were evaluated for both existing and proposed conditions.

Drainage Area 1S – This 6.913 acre area includes the proposed building roof, back parking and access drive, sidewalks, 429 space parking lot, and landscaping throughout the site. All the roof runoff will be routed through a rain garden and surface detention area. Other surface runoff from sidewalk, parking lot and driveway will be collected and routed through water quality units and discharged into infiltration galleys. Runoff will overflow from the infiltration galleys to the discharge point located at the back of the site. Excess runoff will be routed through the on-site drainage collection system for discharge.

Drainage Area 2S – This 1.690 acre area includes a portion of the roof and surrounding landscaped area. Runoff from this area will be routed through an rain garden then overflow onto the Pennsylvania Avenue storm drain system.

Drainage Area 3S – This 1.437 acre area includes the wooded and landscaped area along the back portion of the site.

Table 2 summarizes the key hydrologic parameters for each drainage area used in the proposed conditions analyses.

Table 2
Proposed Conditions Hydrologic Data

Description (Drainage Area #)	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)
1S	Southerly Head Wall	1	6.892	98	5.0
2S	Pennsylvania Ave Storm Drain System	2	1.690	93	6.4
3S	Overland Flow Southwesterly Slope	3	1.437	73	5.0

The site complies fully with the total suspended solids removal requirement of the Stormwater Management Policy. The calculated TSS removal rates for discharges from the site are shown on the Worksheets included in Appendix D.

4

Hydrologic/Hydraulic Analysis

Hydrologic Analysis

The rainfall-runoff response of the Site under existing and proposed conditions was evaluated for storm events with recurrence intervals of 2, 10, 25, and 100-years. Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24-hour storm event for Middlesex County; they were 3.1, 4.6, 5.5, and 6.6 inches, respectively. Runoff coefficients for the pre- and post-development conditions, as previously shown in Tables 1 and 2 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD.

Drainage areas used in the analyses were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology. Detailed printouts of the HydroCAD analyses are included in Appendix E. Table 3 presents a summary of the existing and proposed conditions peak discharge rates.

Table 3
Peak Discharge Rates (cfs*)

Design Point	2-year	10-year	25-year	100-year
Design Point 1: SE Site				
Existing	16.88	27.85	34.39	42.34
Proposed	12.38	21.02	25.99	31.76
%Reduction	26.7%	24.5%	24.4%	25.0%
Design Point 2: Pennsylvania Ave.				
Existing	2.08	3.20	3.87	4.68
Proposed	1.55	2.41	2.77	3.15
% Reduction	25.5%	24.7%	28.4%	32.7%
Design Point 3: SW Site				
Existing	2.30	4.57	6.00	7.78
Proposed	1.42	3.23	4.44	5.97
% Reduction	38.3%	29.3%	26.0%	23.3%

* Expressed in cubic feet per second

The results of the analysis indicate that there is no increase in peak discharge rates between the pre- and post-development conditions for the 2-, 10- . 25- and 100-year storm events.

Table 4
Stormwater Volume Analysis (acre feet)

Design Point	2-year	10-year	25-year	100-year
Design Point 1: SE Site				
Existing	1.38	2.32	2.90	3.61
Proposed	1.08	1.86	2.35	2.95
% Reduction	21.2%	53.9%	19.0%	18.3%
Design Point 2: Pennsylvania Ave.				
Existing	0.14	0.23	0.27	0.34
Proposed	0.26	0.45	0.57	0.71
% Reduction	-46.2%	-48.8%	-52.6%	-52.1%
Design Point 3: SW Site				
Existing	0.15	0.28	0.37	0.48
Proposed	0.11	0.24	0.32	0.43
% Reduction	26.7%	14.3%	13.5%	10.4%

The results of the analysis indicate that there is no increase in discharge volume between the pre- and post-development conditions for the 2-, 10-, 25- and 100-year storm events.

Hydraulic Analysis

The piping for the stormwater drainage system was designed for the 25-year storm event, in accordance with the Town of Framingham by-laws.

Drainage pipes were sized using Manning's Equation for full-flow capacity and the Rational Method. Additionally, the performance of the system was analyzed using StormCAD, a HEC-22 based program. Pipe sizing calculations are included in Appendix F of this report.

Floodplain Information / Analysis

The majority of the site is above the 100 year floodplain which is at an approximate elevation of 184'. The lowest building elevation within the development is 237.5'. Furthermore, the redeveloped part of the site is adjacent to a large sloped area, which provides protection during high water events.

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Stormwater Management Regulations

The purpose of the Stormwater Management Plan is to provide long-term protection of natural resources in and around the Site. This is achieved by implementing water quality and quantity control measures designed to decrease the amount of pollutants discharged from the Site, increase the quality of stormwater recharged on the Site, and control discharge rates.

The following sections describe the regulations pertinent to stormwater management and the specific components of the Plan to be implemented.

Stormwater Regulations and Permitting

The following stormwater related regulations and guidelines apply to the proposed site development:

- Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Stormwater Permit for Construction Activities disturbing greater than one acre.
- Dewatering on a contaminated site requires EPA Remediation General Permit.
- Compliance with these regulations is described in the following sections.

Stormwater Management Standards and Guidelines

The methods for compliance with the ten stormwater performance standards developed by the MA DEP are summarized below.

1. *No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

   The Project will treat the runoff contributed by parking and driveway areas through appropriate stormwater measures. All the stormwater will be discharged through the new headwalls with proper erosion protection.

2. *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

   The post-development discharge rate will be reduced. No further 100 year flood risk increase analysis was performed since both rate and quantity will be reduced in the design storm conditions.

3. *Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

   The annual recharge is expected to increase in the post-development conditions. In addition, infiltration devices will be used to further reduce the volume, which will result in a significant improvement over the existing conditions. The Project will also utilize a number of environmental and low impact design techniques throughout the site to promote groundwater recharge.

4. *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:*
   - *Suitable practices for source control and pollution prevention are identified in a long- term pollution prevention plan, and thereafter are implemented and maintained;*
   - *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
   - *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

   The stormwater quality will be accomplished by using a variety of methods. A Long Term Best Management Practices – Maintenance/ Evaluation check list will be developed (Appendix H) and proper training will be provided to the Stormwater Control Manager. All catch basins will have deep sumps and hoods which will provide 25% TSS removal. All stormwater coming from standard catch basins will be routed through a Stormceptor water quality unit which will remove oil based contaminants and 80% of TSS. The projects average annual post construction load of TSS is projected to be above 80% (see Appendix D). Stormceptor's Sizing Detail Report has been attached to Appendix D to show documentation of sizing and removal rate.

5. *For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

   Since the expectant vehicle trips per day will be greater than 1,000, the proposed site is considered a land use with higher potential pollutant load. Proper BMPs have been incorporated in the design to reduce pollutants from entering the storm water discharge.

6. *Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area, if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply*

   The Project site does not contain or is not located adjacent to any Zone II, or IWPA areas.

7. *A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

   The proposed project will meet Stormwater Management Standards to the maximum extent practicable.

8. *A plan to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

   Recommended erosion and sedimentation control practices are included in Appendix G. A maintenance checklist recommended for evaluating erosion control BMPs is also included in Appendix G.

9. *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

   An Operation and Maintenance plan will be developed and includes, system ownership information, parties responsible for operation and maintenance, and inspection and maintenance schedules. Routine maintenance includes catch basin cleaning, stormwater control cleaning, and removal of debris from outlets. It is also expected that pedestrian and vehicular access ways will be swept appropriately to control sand applied during winter months. Refer to Appendix H.

   Measures aimed at minimizing the disposition of site soils to off-site areas, primarily the surrounding streets and existing drainage collection systems, will be a part of the Town's required Construction Management Plan. In addition, the Proponent will apply for all appropriate permits for construction activity and dewatering. All efforts will be made to contain sediment, pollutants, and any other construction-related materials within the site. Stabilized construction exits will be installed at each access point of the work areas to minimize off-site transport of soil by construction vehicles. These exits will remain in place until site areas have been stabilized. In addition, the Proponent will use Best Management Practices (BMPs) during construction including installing silt sacks on catch basins, anti-tracking pads, and covering material piles.

10. *All illicit discharges to the stormwater management system are prohibited.*

    No known illicit discharges exist at the Project site. Any potential illicit discharges will be eliminated as part of the demolition and cut and cap phase of the project.

Storm drainage structures remaining from the previous development will be removed. The design plans have been designed so that the components included therein are in full compliance with current standards. The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges.

Federal NPDES Construction-Related General Stormwater Permits

The proposed project will result in the disturbance of more than one acre of land and thus requires the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) by the site contractor and owner in accordance with the Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) General Permit Program for Stormwater Discharges from Construction Sites. The SWPPP is not included in this report.

Appendix A: Figures

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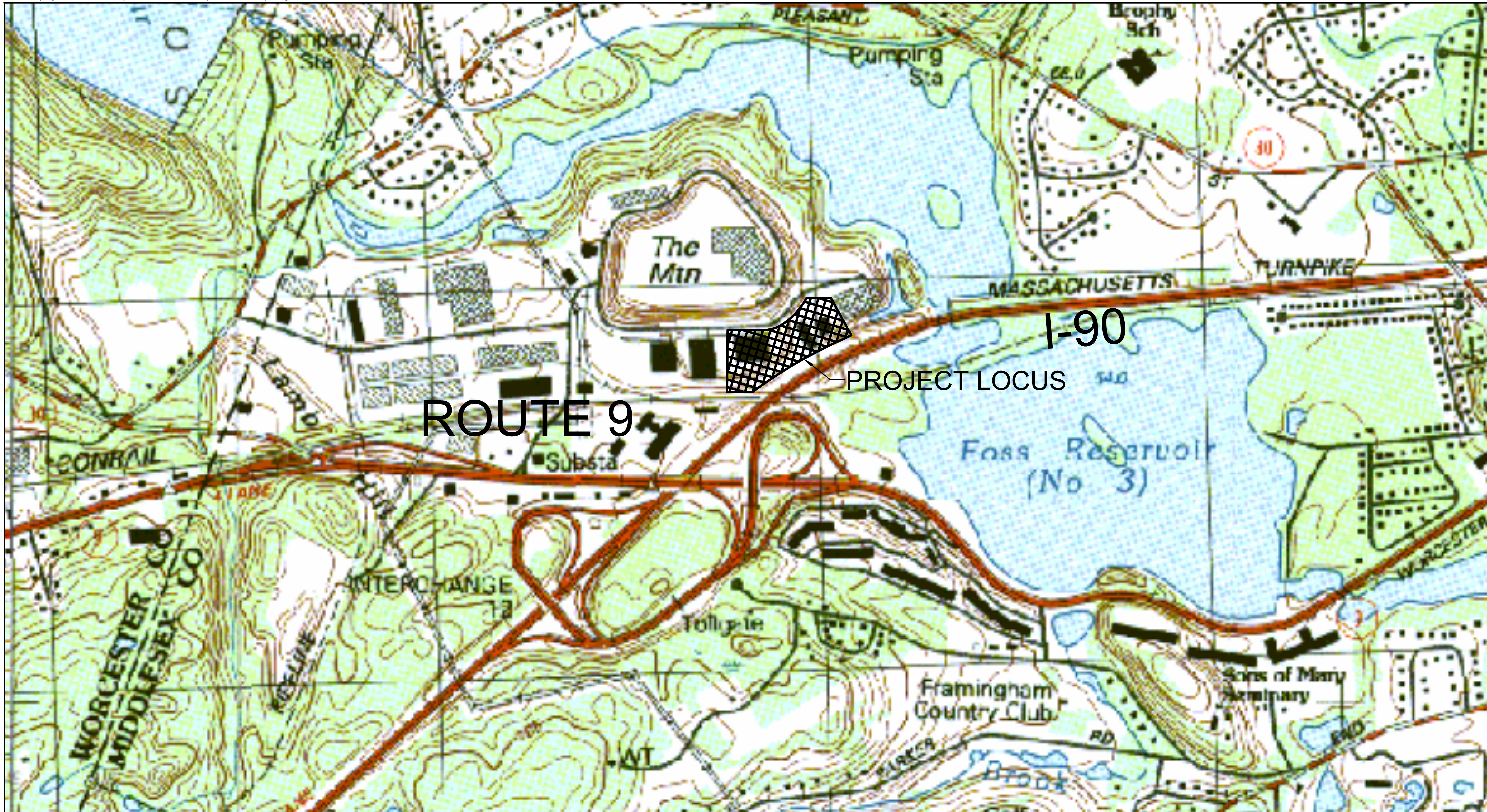

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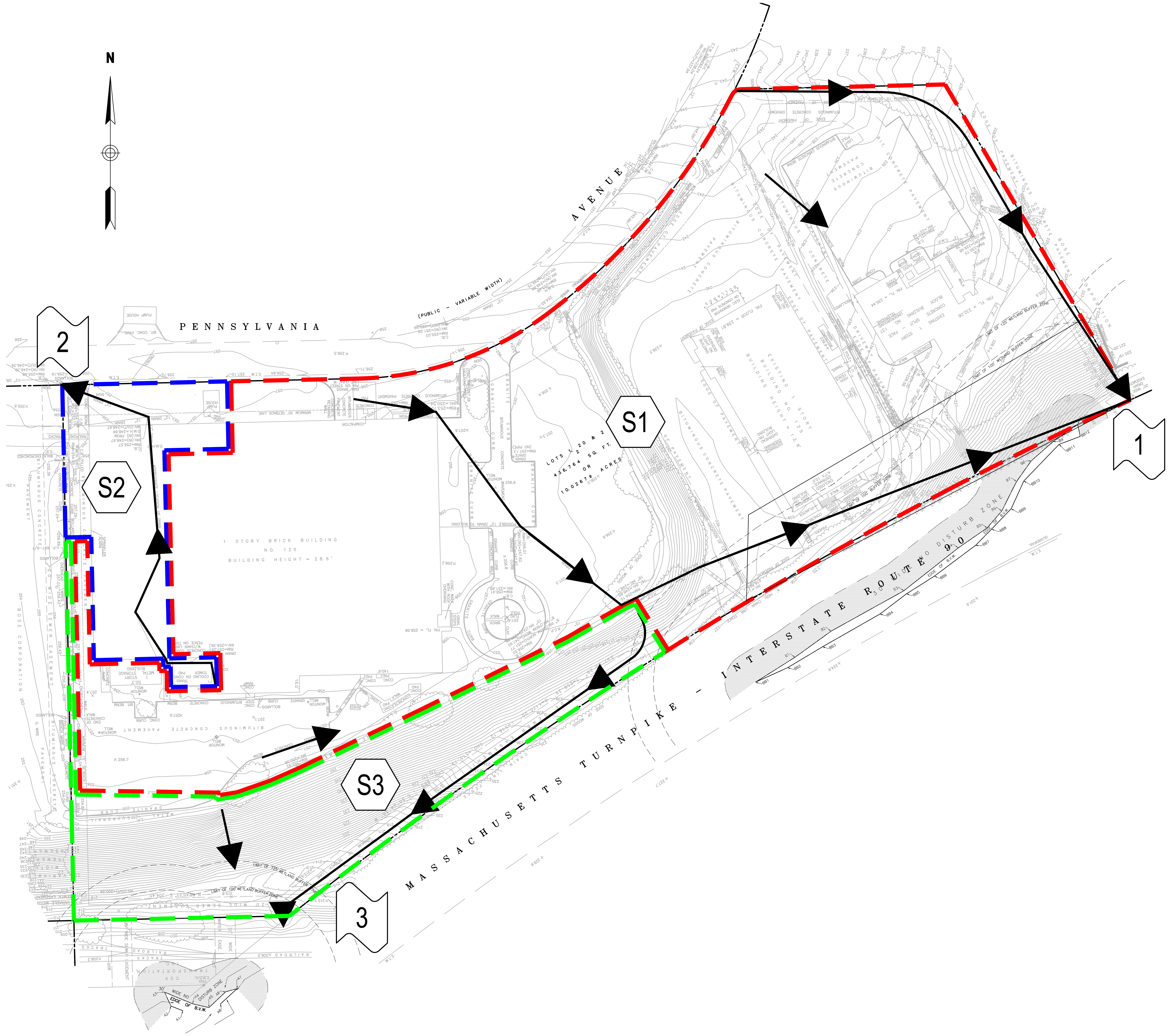
Vanasse Hangen Brustlin, Inc.

Figure No. 1 July 31, 2009

Crossroads Corporate Center
Locus Map



LEGEND

1 SUBCATCHMENT DRAINAGE AREA DESIGNATION

1 DESIGN POINT

DRAINAGE AREA BOUNDARY

TIME OF CONCENTRATION FLOW LINE

SOIL TYPE BOUNDARY

100' BUFFER ZONE

50 0 50 100
SCALE IN FEET

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
99 High Street
Boston, Massachusetts 02110
617.728.7777 • FAX 617.728.7782

No.	Revision	Date	Appvd.

Designed by SARR | Drawn by SARR | Checked by CYM

CAD checked by | Approved by

Scale 1"=50' | Date December 16, 2009

Project Title

125 Pennsylvania Avenue

125 Pennsylvania Avenue
Framingham, Massachusetts

Issued for

Not Approved for Construction

Drawing Title

Existing Drainage Areas

Drawing Number

Sheet 1 of 1

Project Number
10734.00

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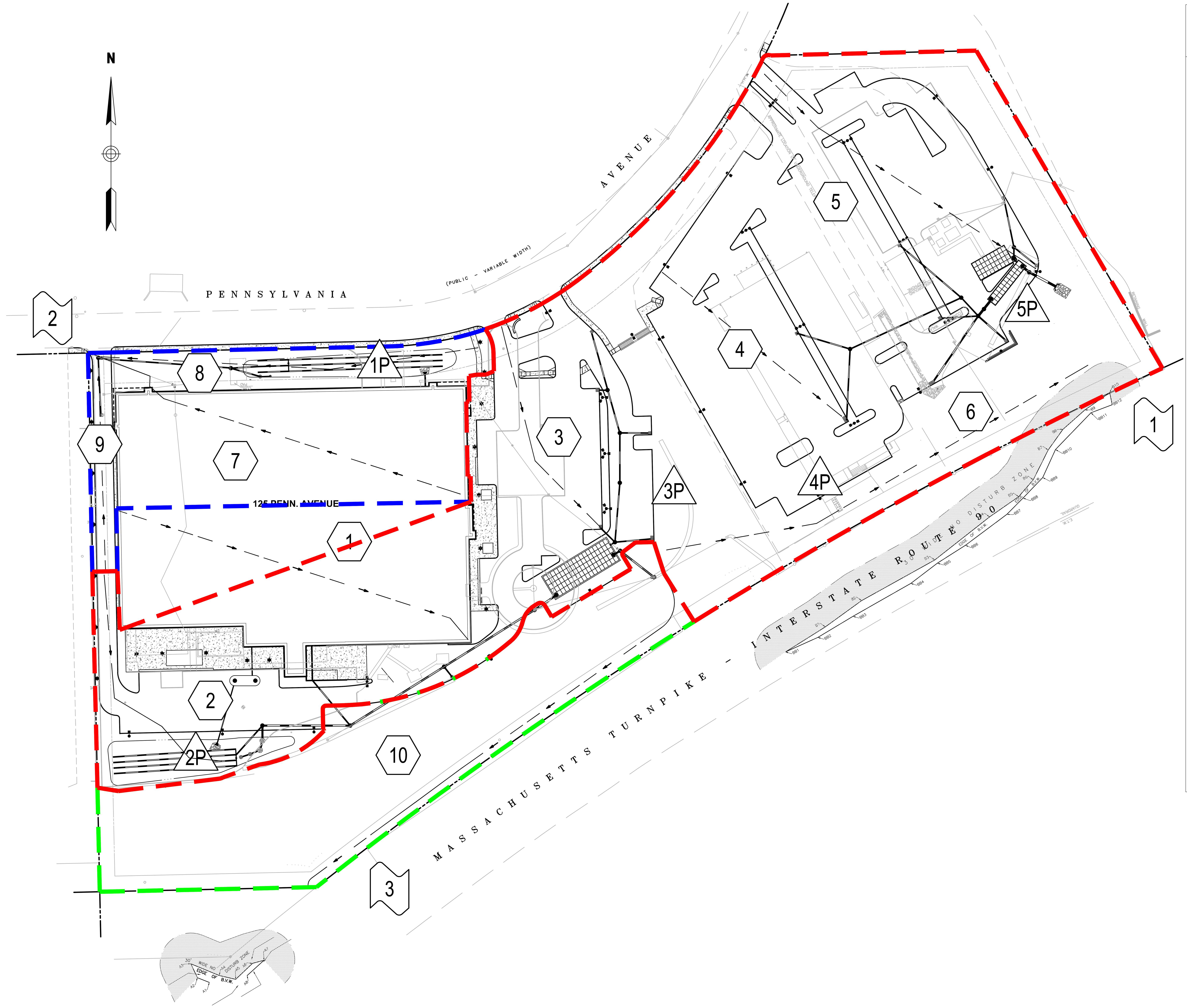

LEGEND

1	SUBCATCHMENT DRAINAGE AREA DESIGNATION
1	POND
1	REACH
1	DESIGN POINT
	DRAINAGE AREA BOUNDARY
	TIME OF CONCENTRATION FLOW LINE
	SOIL TYPE BOUNDARY
	100' BUFFER ZONE

50 0 50 100
SCALE IN FEET

VHB
Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

99 High Street
Boston, Massachusetts 02110
617.728.7777 • FAX 617.728.7782

No.	Revision	Date	Appvd.

Designed by SARR | Drawn by SARR | Checked by CYM
CAD checked by | Approved by
Scale 1"=50' | Date December 15, 2009

Project Title
125 Pensylvania Avenue

125 Pennsylvania Avenue
Framingham, Massachusetts

Issued for

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Drawing Title
Drainage Areas

Drawing Number

Sheet 1 of 1

Project Number
10734.00

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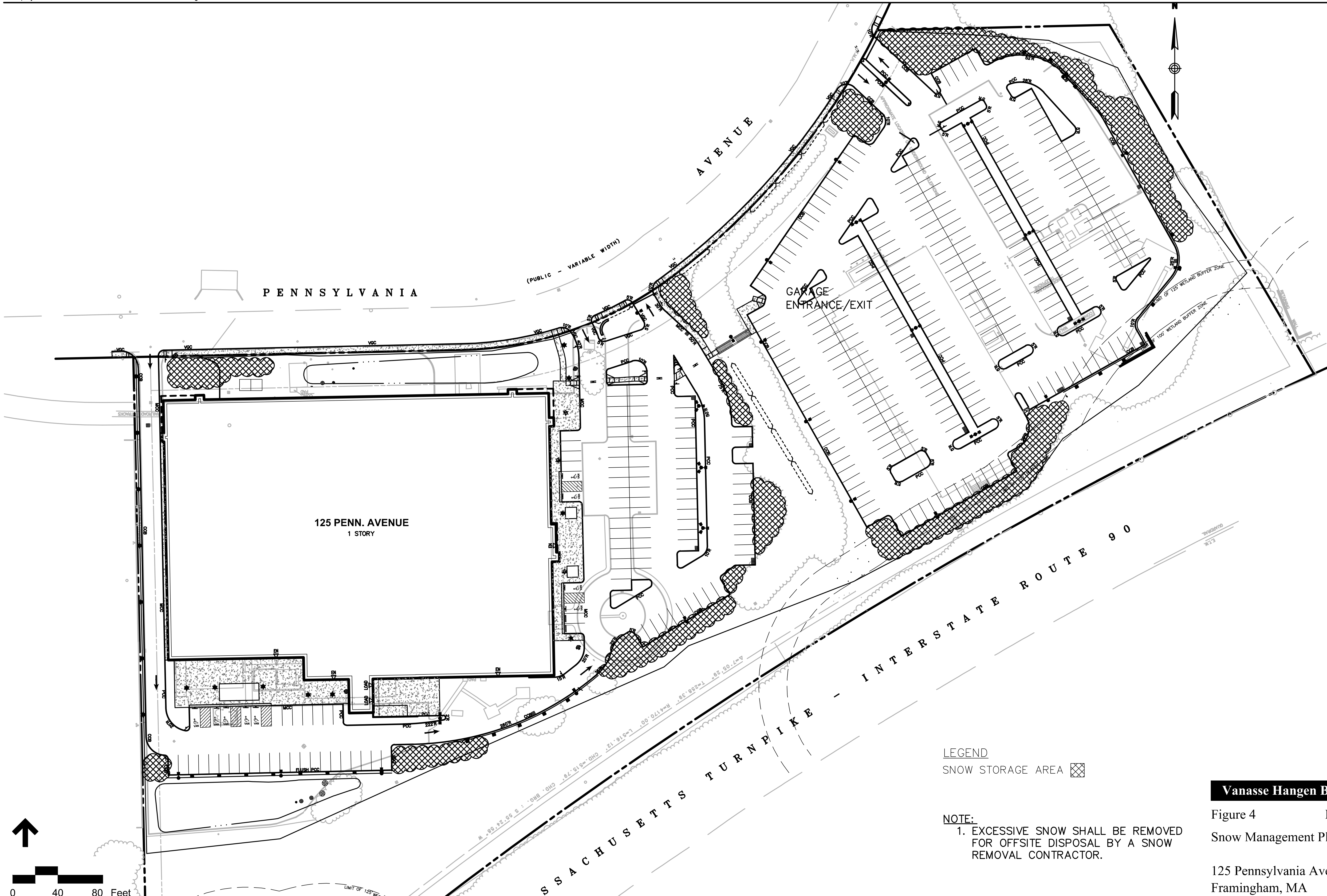

LEGEND

SNOW STORAGE AREA

NOTE:

1. EXCESSIVE SNOW SHALL BE REMOVED FOR OFFSITE DISPOSAL BY A SNOW REMOVAL CONTRACTOR.

Vanasse Hangen Brustlin, Inc.

Figure 4 December 16, 2013

Snow Management Plan

125 Pennsylvania Ave
Framingham, MA

Appendix B:
Floodplain Information

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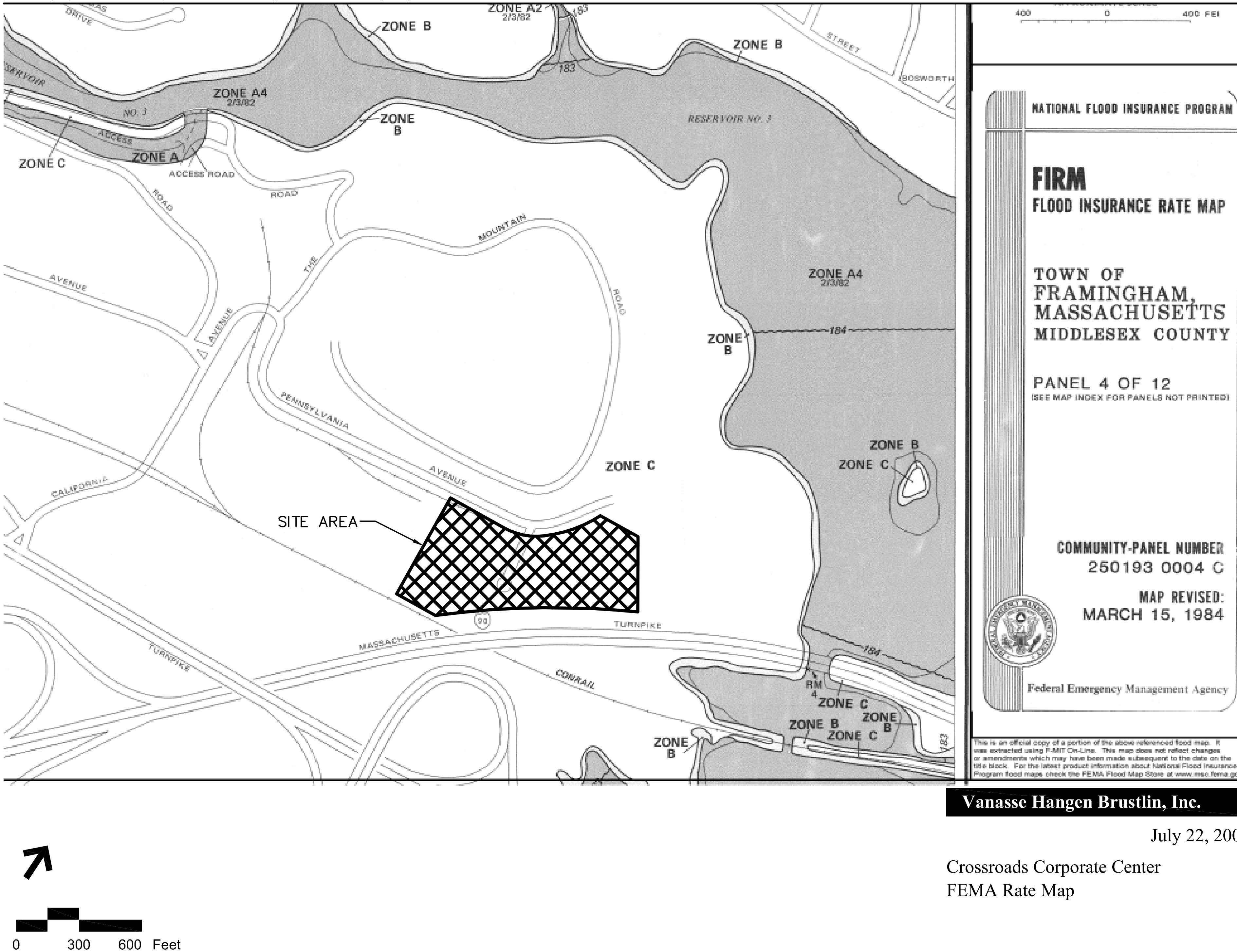

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July 22, 2009

Crossroads Corporate Center
FEMA Rate Map

Appendix C:
Soil Survey Information

NRCS Soil Data

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Middlesex County, Massachusetts

125 Pennsylvania Ave

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,370 if printed on A size (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1,200

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities
- Postal Code

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,370 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:25,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 5, Jan 3, 2007

Date(s) aerial images were photographed: 7/7/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1	Water	0.2	0.3%
223A	Scio very fine sandy loam, 0 to 3 percent slopes	0.6	0.7%
251A	Haven silt loam, 0 to 3 percent slopes	7.2	8.1%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	4.0	4.5%
602	Urban land	61.8	69.2%
654	Udorthents, loamy	15.4	17.2%
Totals for Area of Interest		**89.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

1—Water

Map Unit Setting

Frost-free period: 110 to 200 days

Map Unit Composition

Water: 100 percent

223A—Scio very fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 100 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Scio and similar soils: 85 percent
Minor components: 15 percent

Description of Scio

Setting

Landform: Terraces, depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy glaciolacustrine deposits over silty glaciolacustrine deposits

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Available water capacity: High (about 11.4 inches)

Interpretive groups

Land capability (nonirrigated): 2w

Typical profile

0 to 8 inches: Very fine sandy loam
8 to 35 inches: Very fine sandy loam
35 to 65 inches: Silt loam

Minor Components

Haven

Percent of map unit: 5 percent

Sudbury

Percent of map unit: 5 percent

Tisbury

Percent of map unit: 5 percent

251A—Haven silt loam, 0 to 3 percent slopes

Map Unit Setting

Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Haven and similar soils: 85 percent
Minor components: 15 percent

Description of Haven

Setting

Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 1

Typical profile

0 to 2 inches: Silt loam
2 to 32 inches: Gravelly loam
32 to 65 inches: Error

Minor Components

Merrimac

Percent of map unit: 10 percent

Scio

Percent of map unit: 5 percent

305D—Paxton fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent

Description of Paxton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over dense loamy lodgment till derived from granite and gneiss

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 7 inches: Fine sandy loam
7 to 22 inches: Fine sandy loam
22 to 65 inches: Fine sandy loam

Minor Components

Charlton

Percent of map unit: 8 percent

Montauk

Percent of map unit: 7 percent

602—Urban land

Map Unit Setting

Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents

Percent of map unit: 10 percent

Rock outcrops

Percent of map unit: 5 percent

654—Udorthents, loamy

Map Unit Setting

Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days

Map Unit Composition

Udorthents: 90 percent
Minor components: 10 percent

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Minor Components

Urban land

Percent of map unit: 10 percent

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://soils.usda.gov/

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://soils.usda.gov/

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

Previous Soil Boring Data

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-1 (OW)

Project PHASE II LIMITED SITE INVESTIGATION; 125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client CONGRESS GROUP
Contractor GEOLOGIC, INC.

File No. 34353-002
Sheet No. 1 of 1
Start March 27, 2008
Finish March 27, 2008
Driller R. Eastwood
H&A Rep. B. Babcock
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HSA	SS	--
Inside Diameter (in.)	4	1.25	--
Hammer Weight (lb)	Spin	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures
Rig Make & Model: CME 650 ATV
Bit Type: Cutting Head
Drill Mud: None
Casing: Auger at 11.5 ft
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0							-ASPHALT-	
	6 6 4 7	S1 12	0.3 2.3		0.3	SM	S1: Loose brown, coarse to silty fine SAND and SILT, little coarse to fine gravel, dry -FILL-	0.0/0.0
5	9 12 19 8	S2 12	5.0 7.0		5.0	SM	S2: Dense gray brown, silty coarse to fine SAND, little coarse gravel, some visible bonding, dry -GLACIAL TILL-	0.0/0.0
10	31 64 100/5	S3 14	10.0 11.5			SM	S3: Very dense light brown to brown, silty fine SAND, little coarse to medium sand, little coarse to medium gravel, bonded, dry	0.0/0.0
					11.5		BOTTOM OF EXPLORATION AT 11.5 FT	

NOTE: Auger Refusal at 11.5ft, relocated rig 5.0 ft NE and attempted second boring. Drilled to 10.5 ft and had refusal, moved rig 5.0 ft N of orginal boring and drilled to 11.5 ft. Refusal, set well in competed borehole per D. Montplaisir

NOTE: HA-1 (OW) Dry on 28 March 2008

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					NONE

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 11.5
Rock Cored (ft) -
Samples S3

Boring No. HA-1 (OW)

Field Tests: Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High Plasticity: N - Nonplastic L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Well No. HA-1 (OW)
Boring No. HA-1 (OW)

Project PHASE II LIMITED SITE INVESTIGATION
Location 125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client CONGRESS GROUP
Contractor GEOLOGIC, INC.
Driller R. Eastwood

Initial Water Level (depth bgs) NONE ft

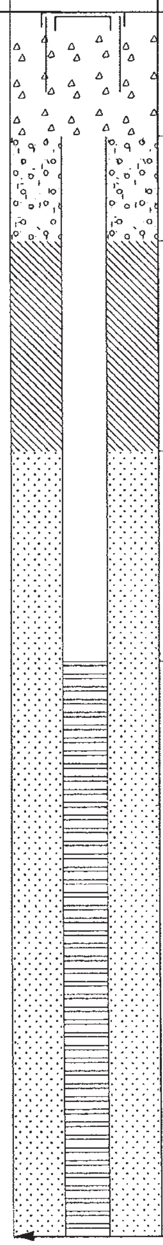
Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 34353-002
Date Installed 27 Mar 2008
H&A Rep. B. Babcock
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)
ASPHALT	0.3
FILL	5.0
GLACIAL TILL	11.5

WELL DETAILS



DEPTH (ft.): 0.0, 1.0, 2.0, 4.0, 6.0, 11.5

ELEVATION (ft.)

WELL CONSTRUCTION DETAILS

Type of protective cover: Compression - hex.

Height of Roadway Box above ground surface: 1.0 ft

Depth of top of riser below ground surface: 0.2 ft

Type of protective casing: Roadway Box

Length: 1.0 ft

Inside diameter: 5.0 in.

Depth of bottom of Roadway Box: 0.0 ft

Type of riser pipe:

Inside diameter of riser pipe:

Depth of bottom of riser pipe: 6.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0 ft	1.0 ft
Bentonite	2.0 ft	2.0 ft
	-	-

Diameter of borehole: 4.0 in.

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 0.010 in.

Diameter of screen: 2.0 in.

Depth to top of well screen: 6.0 ft

Depth to bottom of well screen: 11.0

Bottom of silt trap: 11.0 ft

Depth of bottom of borehole: 11.5 ft

COMMENTS:

HA-LIB07-1.GLB GW INSTALLATION REPORT-07-1 G:\34353\002\FIELD DATA\34353-002TB.GPJ Apr 11, 08

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-2

Project	PHASE II LIMITED SITE INVESTIGATION; 125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client	CONGRESS GROUP
Contractor	GEOLOGIC, INC.

File No.	34353-002
Sheet No.	1 of 1
Start	March 27, 2008
Finish	March 27, 2008
Driller	R. Eastwood
H&A Rep.	B. Babcock
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	SS	--
Inside Diameter (in.)	4	1.25	--
Hammer Weight (lb)	Spin	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 650 ATV
Bit Type: Cutting Head
Drill Mud: None
Casing: Auger at 18.0 ft
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0	12 8 7 3	S1 14	0.2 1.2		0.2	SW	-ASPHALT- S1: Medium dense, brown, fine to coarse SAND, little coarse gravel with silt, dry -FILL-	0.0/0.0
5	1 2 5 2	S2 6	5.0 7.0			SW	S2: Similar to S1 except loose NOTE: Looked down borehole with flashlight, noted possible PVC piping at approximately 6.5 ft, all utilities cleared around borehole, no signs of water or wires in hole or spoon, continued to 10.0 ft with augers	0.0/0.0
					8.0	SW		
10	22 24 35 55	S3 20	10.0 12.0			SW	S3: Very dense brown fine to coarse SAND with fine gravel, silt, very thin bedding visible throughout recovery, occasional partings of red brown coarse sand and light brown, silt, moist to wet NOTE: Advanced augers to 15.0 ft encountered 2.0 to 3.0 ft of running sands in borehole flushed borehole and advanced to 18.0 ft to set well NOTE: Auger cuttings show stratum change to silty SAND and coarse to fine gravel at approximately 16.0 ft -GLACIOFLUVIAL DEPOSITS-	0..0/0.0
15					16.0		-PROBABLE GLACIAL TILL- NOTE: Auger Refusal at 18.0 ft, set well TOP OF PROBABLE BEDROCK 18.0 FT	
					18.0		BOTTOM OF EXPLORATION 18.0 FT	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/27/08	1059	0.5	16.0	18.0	14.1

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	-
Samples	S3

Boring No. HA-2

Field Tests: Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High Plasticity: N - Nonplastic L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Well No.	HA-2
Boring No.	HA-2

Project	PHASE II LIMITED SITE INVESTIGATION
Location	125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client	CONGRESS GROUP
Contractor	GEOLOGIC, INC.
Driller	R. Eastwood
Initial Water Level (depth bgs)	14.1 ft

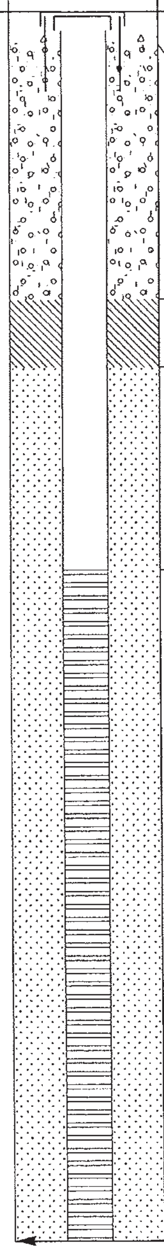
Well Diagram: Riser Pipe; Screen; Filter Sand; Cuttings; Grout; Concrete; Bentonite Seal

File No.	34353-002
Date Installed	27 Mar 2008
H&A Rep.	B. Babcock
Location	See Plan
Ground El.	
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)
ASPHALT	0.2
FILL	8.0
GLACIOFLUVIAL DEPOSITS	16.0
PROBABLE GLACIAL TILL	18.0

Scale (ft): 0, 5, 10, 15

WELL DETAILS



DEPTH (ft.)	ELEVATION (ft.)
0.0	
0.2	
4.0	
5.0	
8.0	
18.0	

WELL CONSTRUCTION DETAILS

Type of protective cover	Compression - pent. bolt
Height of Roadway Box above ground surface	1.0 ft
Depth of top of riser below ground surface	0.2 ft
Type of protective casing	Roadway Box
Length	1.0 ft
Inside diameter	5.0 in.
Depth of bottom of Roadway Box	0.0 ft
Type of riser pipe	
Inside diameter of riser pipe	
Depth of bottom of riser pipe	8.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0 ft	1.0 ft
Bentonite	4.0 ft	2.0 ft
	-	-

Diameter of borehole	4.0 in.
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Depth to top of well screen	8.0 ft
Depth to bottom of well screen	18.0
Bottom of silt trap	18.0 ft
Depth of bottom of borehole	18.0 ft

COMMENTS:

HALEY ALDRICH

DIRECT PUSH PROBE REPORT

DRAFT

Probe No. HA-3

Project PHASE II LIMITED SITE INVESTIGATION, 125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client CONGRESS GROUP
Contractor GEOLOGIC, INC.

File No. 34353-002
Sheet No. 1 of 1
Start March 27, 2008
Finish March 27, 2008
Driller J. Raymond
H&A Rep. B. Babcock

Sampler Diameter (in.): 2.0
Rig Make & Model: Geoprobe
PID Make & Model: MiniRAE 2000 10.6 eV

Elevation
Datum NGVD
Location Former Wastewater Treatment Area

Depth (ft)	Push No. & Depth (ft)	Sample No.& Depth Range	Stratum Change Elev/Depth (ft)	USCS* Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Recovery, color, natural grain size and artificial component percentage estimates, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0	P1 0.0 - 3.0	S1 0.0 - 3.0		SW-SM	S1: Recovered 22.0 in., dark gray to brown gravelly coarse to fine SAND, little silt with concrete dust, PVC plastic, red brick fragments, rubber, dry -FILL-	0.5/0.0
			3.0		BOTTOM OF EXPLORATION AT 3.0 FT NOTE: Collected Environmental Sample for Analysis 0.0 to 3.0 ft	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					DRY

Component Percentage Estimates

Term	Range
adjective modifier	20% - 50%
and	20% - 50%
some	20% - 33%
little	10% - 20%
trace	5% - 10%
with	present

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft) 3.0
Samples S1

Probe No. HA-3

*NOTE: USCS Group Symbols based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

NOTE: Visual-Manual Identification and Description based upon Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description.

HALEY ALDRICH

DIRECT PUSH PROBE REPORT

DRAFT

Probe No. HA-4

Project PHASE II LIMITED SITE INVESTIGATION, 125 PENNSYLVANIA AVENUE, FRAMINGHAM, MA
Client CONGRESS GROUP
Contractor GEOLOGIC, INC.

File No. 34353-002
Sheet No. 1 of 1
Start March 27, 2008
Finish March 27, 2008
Driller J. Raymond
H&A Rep. B. Babcock

Sampler Diameter (in.): 2.0
Rig Make & Model: Geoprobe
PID Make & Model: MiniRAE 2000 10.6 eV

Elevation
Datum NGVD
Location Boiler Room

Depth (ft)	Push No. & Depth (ft)	Sample No.& Depth Range	Stratum Change Elev/Depth (ft)	USCS* Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Recovery, color, natural grain size and artificial component percentage estimates, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0	P1 0.0 - 4.0	S1 0.0 - 4.0		SM	S1: Recovered 18.0 in. of brown to gray brown silty fine SAND, some coarse gravel with concrete fragments, moist -FILL-	0.3/0.0
			4.0		BOTTOM OF EXPLORATION AT 4.0 NOTE: Collected Environmental Sample for Analysis from 0.0 to 4.0 ft	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					NONE

Component Percentage Estimates

Term	Range
adjective modifier	20% - 50%
and	20% - 50%
some	20% - 33%
little	10% - 20%
trace	5% - 10%
with	present

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

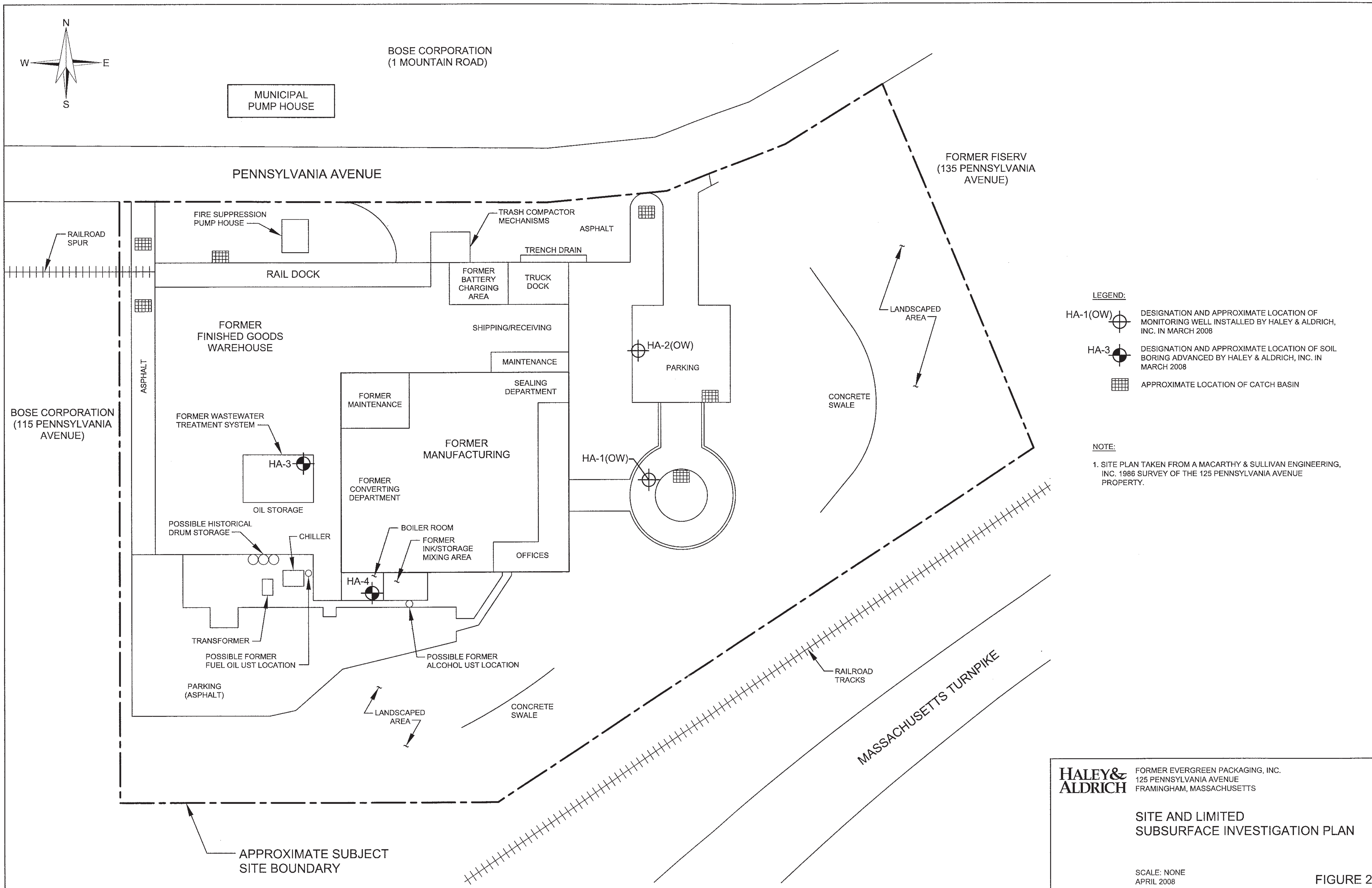
Summary

Overburden (ft) 4.0
Samples S1

Probe No. HA-4

*NOTE: USCS Group Symbols based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

NOTE: Visual-Manual Identification and Description based upon Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description.


N
W
E
S
BOSE CORPORATION
(1 MOUNTAIN ROAD)
MUNICIPAL
PUMP HOUSE
PENNSYLVANIA AVENUE
FORMER FISERV
(135 PENNSYLVANIA
AVENUE)
RAILROAD
SPUR
FIRE SUPPRESSION
PUMP HOUSE
TRASH COMPACTOR
MECHANISMS
ASPHALT
TRENCH DRAIN
RAIL DOCK
FORMER
BATTERY
CHARGING
AREA
TRUCK
DOCK
SHIPPING/RECEIVING
MAINTENANCE
SEALING
DEPARTMENT
FORMER
FINISHED GOODS
WAREHOUSE
ASPHALT
BOSE CORPORATION
(115 PENNSYLVANIA
AVENUE)
FORMER WASTEWATER
TREATMENT SYSTEM
HA-3
OIL STORAGE
FORMER
MAINTENANCE
FORMER
MANUFACTURING
FORMER
CONVERTING
DEPARTMENT
HA-2(OW)
PARKING
HA-1(OW)
LANDSCAPED
AREA
CONCRETE
SWALE
POSSIBLE HISTORICAL
DRUM STORAGE
CHILLER
BOILER ROOM
FORMER
INK/STORAGE
MIXING AREA
OFFICES
HA-4
TRANSFORMER
POSSIBLE FORMER
FUEL OIL UST LOCATION
POSSIBLE FORMER
ALCOHOL UST LOCATION
PARKING
(ASPHALT)
LANDSCAPED
AREA
CONCRETE
SWALE
RAILROAD
TRACKS
MASSACHUSETTS TURNPIKE
APPROXIMATE SUBJECT
SITE BOUNDARY
J:\GRAPHICS\34353\34353-002-B003.DWG
LEGEND:
HA-1(OW) DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL INSTALLED BY HALEY & ALDRICH, INC. IN MARCH 2008
HA-3 DESIGNATION AND APPROXIMATE LOCATION OF SOIL BORING ADVANCED BY HALEY & ALDRICH, INC. IN MARCH 2008
APPROXIMATE LOCATION OF CATCH BASIN
NOTE:
1. SITE PLAN TAKEN FROM A MACARTHY & SULLIVAN ENGINEERING, INC. 1986 SURVEY OF THE 125 PENNSYLVANIA AVENUE PROPERTY.
HALEY& ALDRICH
FORMER EVERGREEN PACKAGING, INC.
125 PENNSYLVANIA AVENUE
FRAMINGHAM, MASSACHUSETTS
SITE AND LIMITED
SUBSURFACE INVESTIGATION PLAN
SCALE: NONE
APRIL 2008
FIGURE 2

*DITCHES - none

* OTHER - none

4. ENVIRONMENTAL CHARACTERISTICS RELATIVE TO HAZARDOUS MATERIALS (see attached site plan):

* TOPOGRAPHY AND SURFACE WATER DRAINAGE PATTERNS - Topography slopes moderately to the southeast, except behind the building where a steep east-west striking ravine separates the building from the turnpike. Surface water drainage is through a system of catch basins, waterways and pipes which lead to the ravine.

* SOIL TYPES AND PERMEABILITIES - Soil types encountered are described in Appendix A, test pit logs. With the exception of the thin topsoil, all sediments were a poorly sorted and poorly permeable material that is most probably fill.

* SURFICIAL AND BEDROCK GEOLOGY - Natural surficial or bedrock deposits materials were not encountered.

* DEPTH TO GROUNDWATER - Ground water was not encountered in the test pits, which were up to 10 feet deep.

* GROUNDWATER FLOW DIRECTION - Ground water flow direction was not determined but presumably follows topography and flows southeast.

* PONDS, STREAMS, WETLANDS AND FLOODPLAINS - None on site, as discussed above.

* ON-SITE AND OTHER DRINKING WATER SUPPLIES (surface or underground) within 1,000 feet of the site - None

* CONDITION OF VEGETATION - Healthy

III. SITE HISTORY AND USE

1. ZONING: PRESENT CLASSIFICATION AND DATES:
   The site has been soned industrial since 1955.

   PRIOR CLASSIFICATION AND DATES:
   Zoning was instituted in Framingham in 1939, at which time the site was zoned for business. It remained so zoned until 1955.

2. CURRENT USES OF SITES: Commercial

3. BRIEF DESCRIPTION OF CURRENT USES: (described in terms of products made, materials used, wastes generated, etc.)

The site is used as a sales office for the Allen Bradley Co., which makes switches, controls and other specialty electronic parts. The building has a small warehouse area. Warehousing is not presently done on the site by Allen Bradley, but was in the past.

4. BRIEF DESCRIPTION OF FORMER SITE USES: (described by dates of such use and other information relative to waste generation and disposal)

Allen Bradley has occupied the building since it was built approximately 15 years ago.

5. CURRENT AND FORMER USES OF SURROUNDING PROPERTIES: The site sits in the Framingham Industrial Park. Prime Computer, which manufactures computers, abuts to the northeast. NCR, which does data processing, abuts to the southwest. Across Pennsylvania Ave. and hydrologically upgradient, the Bose Corp. has its manufacturing facilities and corporate headquarters.

LIST OF ENVIRONMENTAL PERMITS HELD BY CURRENT AND FORMER SITE OWNERS: None were listed with the Town Clerk, Board of Health or Fire Department.

7. SUMMARY OF PRIOR CITATIONS OR FINES FOR VIOLATIONS OF ENVIRONMENTAL REGULATIONS: None listed with the above agencies.

IV. SUMMARY OF SITE INSPECTION AND INVESTIGATIONS

1. PERSONS INTERVIEWED RELATIVE TO SITE HISTORY AND USE:

Assessors Office, Framingham Town Hall, 620-4858
Town Clerk's Office, Framingham Town Hall, 620-4862
Rena Berardi, Planning Bd., Framingham Town Hall, 620-4852

Bill Fegan, Engineering Office, Framingham Town Hall, 620-4844

Board of Health. Framingham Town Hall, 620-4827
Public Works Dept., Framingham Town Hall, 620-4880
Capt. Pillarella, Framingham Fire Dept.,620-4943

2. SURFACE SOIL AND SEDIMENT SAMPLING LOCATIONS, METHODS AND ANALYTICAL RESULTS:

* SURFACE SOILS - none

* SEDIMENTS - Sediment samples were taken from the test pits - see below.

* TEST PIT LOCATIONS AND LOGS - See figure 2, site plan for locations and Appendix A for logs. Two test pits were dug in the lawn on the east side of the building. Location of underground utilities and paved areas prevented pits from being dug on the west side. Two pits were started in the narrow area between the building and the ravine; these dug up an electrical cable going to the large sign behind the building and a small PVC pipe that was part of the sprinkler system. No other pits were attempted in this small area.

* ANALYTICAL RESULTS - HNU meter analyses on samples collected from the test pits yielded values equal to ambient background.

* INTERPRETATION OF RESULTS - HNU analyses indicate the site to be free of pollution by organic pollutants with a volatile component such as solvents, gasoline, fuel oil, etc.

3. SURFACE WATER SAMPLING LOCATIONS AND ANALYTICAL RESULTS: No surface water samples were collected.

4. SUBSURFACE WATER AND GROUNDWATER SAMPLING, LOCATIONS AND ANALYTICAL RESULTS:

   * BORING LOCATIONS AND LOGS - None

   * MONITORING WELL LOCATIONS, ELEVATIONS AND LOGS - None

   * SUBSURFACE SOIL SAMPLE DEPTHS - See Appendix A, Test Pit Logs

   * GROUNDWATER FLOW RATES AND DIRECTIONS- Ground water was not encountered in the test pits, so flow rate and direction was not determined. Flow direction probably follows topography to the SE.

   * ANALYTICAL RESULTS - Subsurface sampling is discussed in the previous section. *

5. OTHER SAMPLING LOCATIONS AND ANALYTICAL RESULTS:

* UNDERGROUND TANKS - None
* DISCHARGE LINES - None
* LAGOONS AND PITS - None

6. RESULTS OF OTHER GEOPHYSICAL INVESTIGATIONS: (if applicable)
No geophysical work was performed.

V. CONCLUSIONS

1. IDENTIFICATION OF PERSONNEL CONDUCTING THE SITE INSPECTION AND INVESTIGATION:

Walter Mulica, Senior Hydrogeologist, IEP Inc.
Cedwyn Morgan, Geochemist, IEP Inc.
Martha Snow, Geologist, IEP Inc.

2. CONCLUSIONS OF THE INSPECTIONS AND INVESTIGATIONS INCLUDING ANY LIMITATIONS THERETO:

Background research indicates that the site has no history of hazardous waste generation. Test pits dug on the property reveal no visual or volatile organic evidence of contamination. Visual inspection of the site and ravine revealed no evidence of illicit dumping. Based upon these findings, IEP Inc. concludes that this site, 137 Pennsylvanis Ave., Framingham MA, is free of hazardous waste as legislated under MGL Chapter 21E.

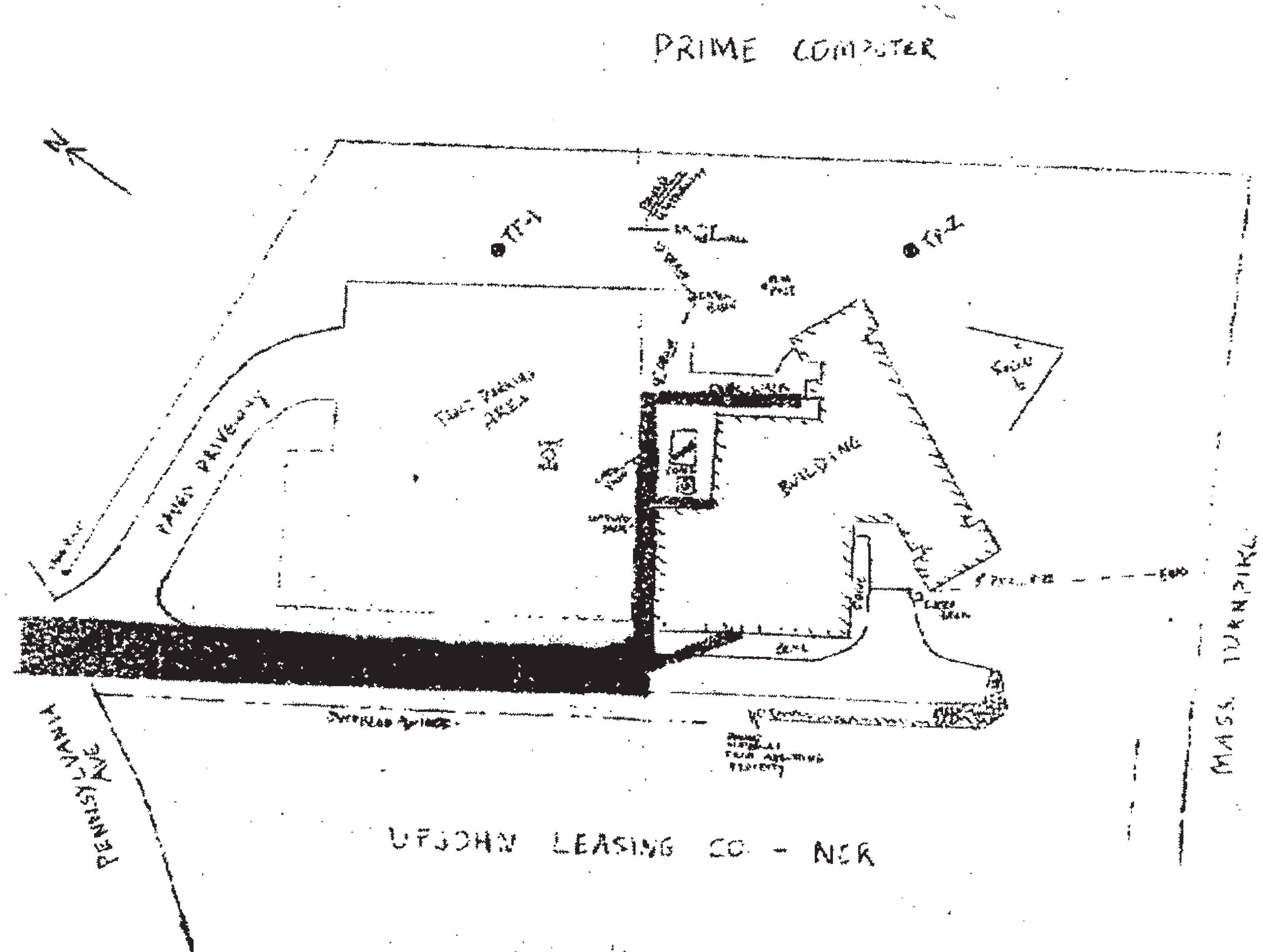
SOIL TEST PIT LOG

PROJECT: Allen Bradley Bldg Framingham 21E	PROJECT NO.: Byrne-1
LOCATION: 137 Pennsylvania Ave Framingham MA	ELEVATION AND DATUM:
EXCAVATION CONTRACTOR: S & G Construction Ron	DATE: 3/5/85 — COMPLETION DEPTH:
EXCAVATION EQUIPMENT: Backhoe	OBSERVED WATER LEVEL DATA: Not Observed

ELEV.	DESCRIPTION	DEPTH SCALE	SAMPLE NO. LOC	SAMPLE TYPE	REMARKS
	topsoil				Lawn
	tan clayey silt with little sand and some cobbles & boulders. Very poorly sorted	1–3			prob. fill
		5	1	Soil	Hnu readings = Bckgrnd for both soil samples
		9.5	2	Soil	
	Bottom of Hole	10			
		13			logged by Cedwyn Morgan, Geologist

FIG. 2
Site Plan

Modified by IEP, Inc.
3/84
from a plan
by
Joseph R Sullivan
12/27/82



- Stippled areas are underlain by utility lines (water, sewer, electric, telephone and gas)

• = Test Pit

Appendix D:
TSS Removal Worksheets

TSS Removal Calculation Worksheet

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
99 High Street, 10th Floor
Boston, MA 02110
(617) 728-7777

Project Name:	**125 Pennsylvania Ave.**	Sheet:	**1 of 4**
Project Number:	**10734.00**	Date:	**16-Dec-2013**
Location:	**Framingham, MA**	Computed by:	**MCJ**
Discharge Point:	**1**	Checked by:	**C Man**
Drainage Area(s):	**Back Parking lot/ Loading**		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Street Sweeping - 5% (Quarterly)	**5%**	**1.00**	**0.05**	**0.95**
Bioretention Area	**90%**	**0.95**	**0.86**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 80% removal is used for this calculation (Change name of device and the claimed removal rate shown on the calc. sheet. Remove this sentence if not applicable.

Treatment Train TSS Removal = **91%**

TSS Removal Calculation Worksheet

VHB

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
99 High Street, 10th Floor
Boston, MA 02110
(617) 728-7777

Project Name:	**125 Pennsylvania Ave.**	Sheet:	**2 of 4**
Project Number:	**10734.00**	Date:	**16-Dec-2013**
Location:	**Framingham, MA**	Computed by:	**MCJ**
Discharge Point:	**1**	Checked by:	**C Man**
Drainage Area(s):	**Upper Parkign Level**		

A BMP*	B TSS Removal Rate*	C Starting TSS Load**	D Amount Removed (C*D)	E Remaining Load (D-E)
VortSentry HS36G (Pre-Treatment)	**52%**	**1.00**	**0.52**	**0.48**
Street Sweeping - 5% (Quarterly)	**5%**	**0.48**	**0.02**	**0.46**
Subsurface Infiltration Structure	**80%**	**0.46**	**0.36**	**0.09**
	0%	**0.09**	**0.00**	**0.09**
	0%	**0.09**	**0.00**	**0.09**

Treatment Train TSS Removal = 91%

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 80% removal is used for this calculation (Change name of device and the claimed removal rate shown on the calc. sheet. Remove this sentence if not applicable.

VortSentry® HS Estimated Net Annual TSS Reduction

CROSSROADS CORPORATE CENTER
FRAMINGHAM, MA
Model VSHS36
System WQU

Design Ratio[1] = $\frac{\text{0.17 acres x 0.9}}{\text{27 ft3}}$ **= 0.006**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.00	0.00012	10.2%	98.0%	10.0%
0.04	0.01	0.00023	9.6%	98.0%	9.5%
0.06	0.01	0.00035	9.4%	98.0%	9.3%
0.08	0.01	0.00046	7.7%	98.0%	7.6%
0.10	0.02	0.00058	8.6%	98.0%	8.4%
0.12	0.02	0.00069	6.3%	98.0%	6.2%
0.14	0.02	0.00081	4.7%	98.0%	4.6%
0.16	0.02	0.00092	4.6%	98.0%	4.5%
0.18	0.03	0.00104	3.5%	98.0%	3.5%
0.20	0.03	0.00115	4.3%	98.0%	4.3%
0.25	0.04	0.00144	8.0%	98.0%	7.8%
0.30	0.05	0.00173	5.6%	98.0%	5.5%
0.35	0.05	0.00202	4.4%	98.0%	4.3%
0.40	0.06	0.00231	2.5%	98.0%	2.5%
0.45	0.07	0.00260	2.5%	98.0%	2.5%
0.50	0.08	0.00289	1.4%	98.0%	1.4%
0.75	0.11	0.00433	5.0%	98.0%	4.9%
1.00	0.15	0.00577	1.0%	98.0%	1.0%
1.50	0.23	0.00866	0.0%	97.8%	0.0%
2.00	0.31	0.01154	0.0%	93.0%	0.0%
3.00	0.46	0.01732	0.5%	88.4%	0.4%
					98.0%
				% rain falling at >0"/hr =	0.0%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**91.5%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.

2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio

3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: JAG	Date: 12/20/13	Checked by:	Date:

VortSentry® HS Estimated Net Annual TSS Reduction

CROSSROADS CORPORATE CENTER
FRAMINGHAM, MA
Model VSHS36
System WQU 2

Design Ratio[1] = $\frac{0.39 \text{ acres} \times 0.9}{27 \text{ ft3}}$ **= 0.013**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.01	0.00026	10.2%	98.0%	10.0%
0.04	0.01	0.00053	9.6%	98.0%	9.5%
0.06	0.02	0.00079	9.4%	98.0%	9.3%
0.08	0.03	0.00106	7.7%	98.0%	7.6%
0.10	0.04	0.00132	8.6%	98.0%	8.4%
0.12	0.04	0.00159	6.3%	98.0%	6.2%
0.14	0.05	0.00185	4.7%	98.0%	4.6%
0.16	0.06	0.00212	4.6%	98.0%	4.5%
0.18	0.06	0.00238	3.5%	98.0%	3.5%
0.20	0.07	0.00265	4.3%	98.0%	4.3%
0.25	0.09	0.00331	8.0%	98.0%	7.8%
0.30	0.11	0.00397	5.6%	98.0%	5.5%
0.35	0.12	0.00463	4.4%	98.0%	4.3%
0.40	0.14	0.00530	2.5%	98.0%	2.5%
0.45	0.16	0.00596	2.5%	98.0%	2.5%
0.50	0.18	0.00662	1.4%	98.0%	1.4%
0.75	0.26	0.00993	5.0%	95.7%	4.8%
1.00	0.35	0.01324	0.8%	89.6%	0.7%
1.50	0.53	0.01986	0.0%	83.3%	0.0%
2.00	0.70	0.02648	0.0%	67.7%	0.0%
3.00	1.05	0.03973	0.5%	25.3%	0.1%
					97.3%
				% rain falling at >0"/hr =	0.2%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**90.8%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: JAG	Date: 12/20/13	Checked by:	Date:

TSS Removal Calculation Worksheet

VHB

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
99 High Street, 10th Floor
Boston, MA 02110
(617) 728-7777

Project Name:	**125 Pennsylvania Ave.**	Sheet:	**3 of 4**
Project Number:	**10734.00**	Date:	**16-Dec-2013**
Location:	**Framingham, MA**	Computed by:	**MCJ**
Discharge Point:	**1**	Checked by:	**C Man**
Drainage Area(s):	**Lower Level Parking**		

A BMP*	B TSS Removal Rate*	C Starting TSS Load**	D Amount Removed (C*D)	E Remaining Load (D-E)
Street Sweeping - 5% (Quarterly)	**5%**	**1.00**	**0.05**	**0.95**
Deep Sump and Hooded Catch Basin	**25%**	**0.95**	**0.24**	**0.71**
CDS 2015-4 &5	**52%**	**0.71**	**0.37**	**0.34**
Subsurface Infiltration Structure	**80%**	**0.34**	**0.27**	**0.07**
	0%	**0.07**	**0.00**	**0.07**

Treatment Train TSS Removal = **93%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 80% removal is used for this calculation (Change name of device and the claimed removal rate shown on the calc. sheet. Remove this sentence if not applicable.

CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

CROSSROADS CORPORATE CENTER
FRAMINGHAM, MA
for SYSTEM: WQU 3

Area	1.92	acres	CDS Model	
Weighted C	0.90		2025-5	
Tc	5	minutes	CDS Treatment Capacity	
			3.2	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.03	0.03	100.0	10.2
0.04	9.6%	19.8%	0.07	0.07	100.0	9.6
0.06	9.4%	29.3%	0.10	0.10	99.8	9.4
0.08	7.7%	37.0%	0.14	0.14	99.3	7.7
0.10	8.6%	45.6%	0.17	0.17	98.8	8.5
0.12	6.3%	51.9%	0.21	0.21	98.3	6.2
0.14	4.7%	56.5%	0.24	0.24	97.8	4.6
0.16	4.6%	61.2%	0.28	0.28	97.3	4.5
0.18	3.5%	64.7%	0.31	0.31	96.8	3.4
0.20	4.3%	69.1%	0.35	0.35	96.2	4.2
0.25	8.0%	77.1%	0.43	0.43	95.0	7.6
0.30	5.6%	82.7%	0.52	0.52	93.7	5.2
0.35	4.4%	87.0%	0.60	0.60	92.4	4.0
0.40	2.5%	89.5%	0.69	0.69	91.1	2.3
0.45	2.5%	92.1%	0.78	0.78	89.8	2.3
0.50	1.4%	93.5%	0.86	0.86	88.6	1.2
0.75	5.0%	98.5%	1.30	1.30	82.1	4.1
1.00	1.0%	99.5%	1.73	1.73	75.7	0.8
1.50	0.0%	99.5%	2.59	2.59	62.9	0.0
2.00	0.0%	99.5%	3.46	3.20	49.9	0.0
3.00	0.5%	100.0%	5.18	3.20	33.3	0.2
						96.0
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.4%
					Predicted Net Annual Load Removal Efficiency =	**89.6%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

CROSSROADS CORPORATE CENTER
FRAMINGHAM, MA
for SYSTEM: WQU 4

Area	0.44	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	5	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	100.0	10.2
0.04	9.6%	19.8%	0.02	0.02	100.0	9.6
0.06	9.4%	29.3%	0.02	0.02	100.0	9.4
0.08	7.7%	37.0%	0.03	0.03	100.0	7.7
0.10	8.6%	45.6%	0.04	0.04	100.0	8.6
0.12	6.3%	51.9%	0.05	0.05	99.8	6.3
0.14	4.7%	56.5%	0.06	0.06	99.5	4.6
0.16	4.6%	61.2%	0.06	0.06	99.2	4.6
0.18	3.5%	64.7%	0.07	0.07	99.0	3.5
0.20	4.3%	69.1%	0.08	0.08	98.7	4.3
0.25	8.0%	77.1%	0.10	0.10	98.0	7.8
0.30	5.6%	82.7%	0.12	0.12	97.3	5.4
0.35	4.4%	87.0%	0.14	0.14	96.7	4.2
0.40	2.5%	89.5%	0.16	0.16	96.0	2.4
0.45	2.5%	92.1%	0.18	0.18	95.3	2.4
0.50	1.4%	93.5%	0.20	0.20	94.7	1.3
0.75	5.0%	98.5%	0.30	0.30	91.3	4.6
1.00	1.0%	99.5%	0.40	0.40	87.9	0.9
1.50	0.0%	99.5%	0.59	0.59	81.2	0.0
2.00	0.0%	99.5%	0.79	0.79	74.5	0.0
3.00	0.5%	100.0%	1.19	1.19	61.1	0.3
						98.3
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.5%
					Predicted Net Annual Load Removal Efficiency =	**91.9%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

TSS Removal Calculation Worksheet

VHB

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
99 High Street, 10th Floor
Boston, MA 02110
(617) 728-7777

Project Name:	125 Pennsylvania Ave.		Sheet:	4 of 4
Project Number:	10734.00		Date:	16-Dec-2013
Location:	Framingham, MA		Computed by:	MCJ
Discharge Point:	2		Checked by:	C Man
Drainage Area(s):	Building/Frontage			

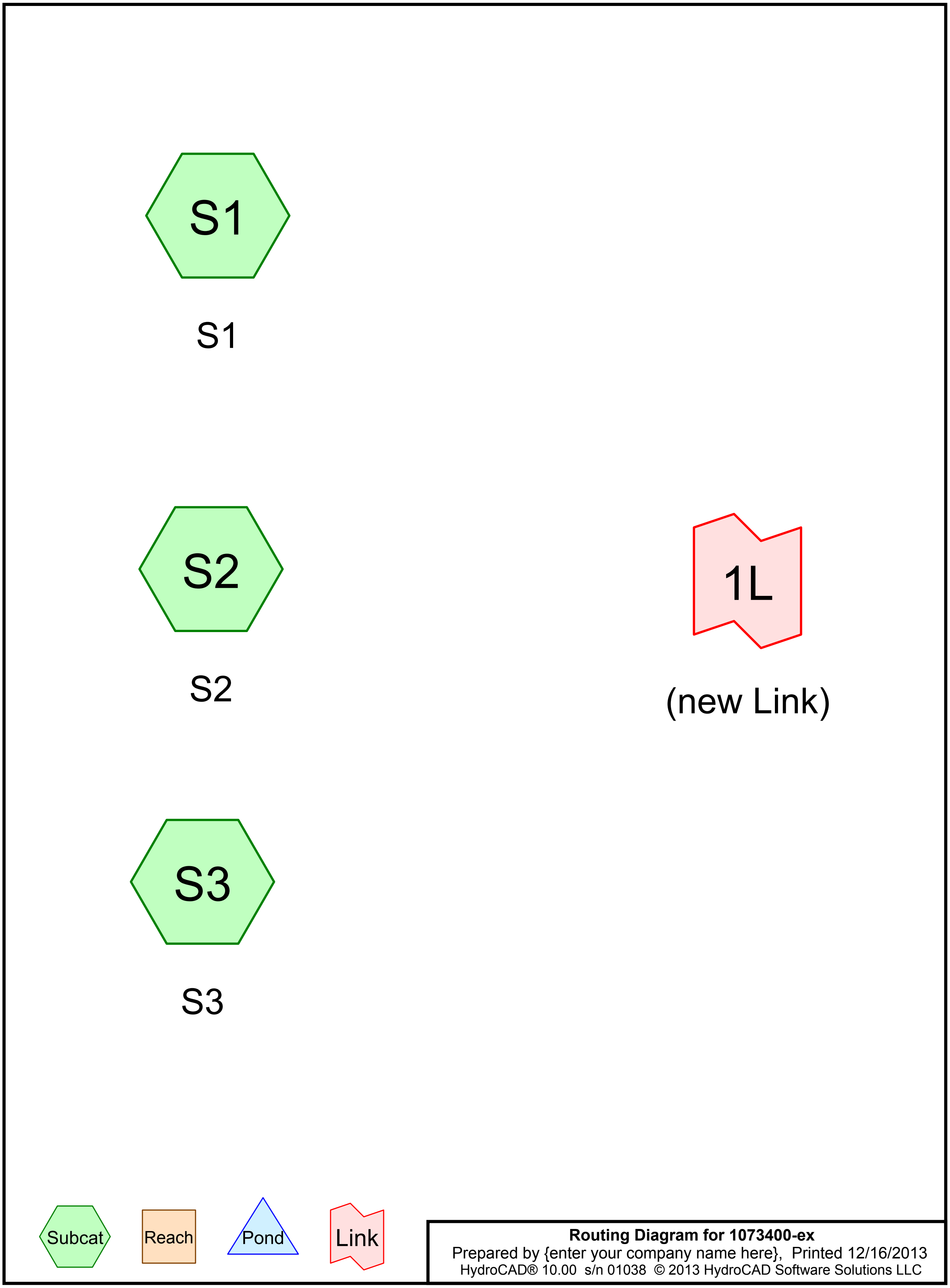
A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Rain Garden	**90%**	**1.00**	**0.90**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 80% removal is used for this calculation (Change name of device and the claimed removal rate shown on the calc. sheet. Remove this sentence if not applicable.

Treatment Train TSS Removal = **90%**

Appendix E:
Hydrologic Analysis

HydroCAD Analysis: Existing Conditions



Routing Diagram for 1073400-ex
Prepared by {enter your company name here}, Printed 12/16/2013
HydroCAD® 10.00 s/n 01038 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.070	79	50-75% Grass cover, Fair, HSG C (S1, S2, S3)
5.337	98	Paved parking & roofs (S1, S2, S3)
0.620	73	Woods, Fair, HSG C (S1, S3)
10.027	**89**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentS1: S1 Runoff Area=7.980 ac 59.41% Impervious Runoff Depth=2.08"
Flow Length=830' Slope=0.1200 '/' Tc=9.9 min CN=90 Runoff=16.88 cfs 1.381 af

SubcatchmentS2: S2 Runoff Area=0.670 ac 82.09% Impervious Runoff Depth=2.55"
Flow Length=150' Slope=0.0100 '/' Tc=3.4 min CN=95 Runoff=2.08 cfs 0.142 af

SubcatchmentS3: S3 Runoff Area=59,995 sf 3.35% Impervious Runoff Depth=1.26"
Flow Length=420' Slope=0.4000 '/' Tc=2.2 min CN=79 Runoff=2.30 cfs 0.145 af

Link 1L: (new Link)
Primary=0.00 cfs 0.000 af

Total Runoff Area = 10.027 ac Runoff Volume = 1.668 af Average Runoff Depth = 2.00"
46.77% Pervious = 4.690 ac 53.23% Impervious = 5.337 ac

Summary for Subcatchment S1: S1

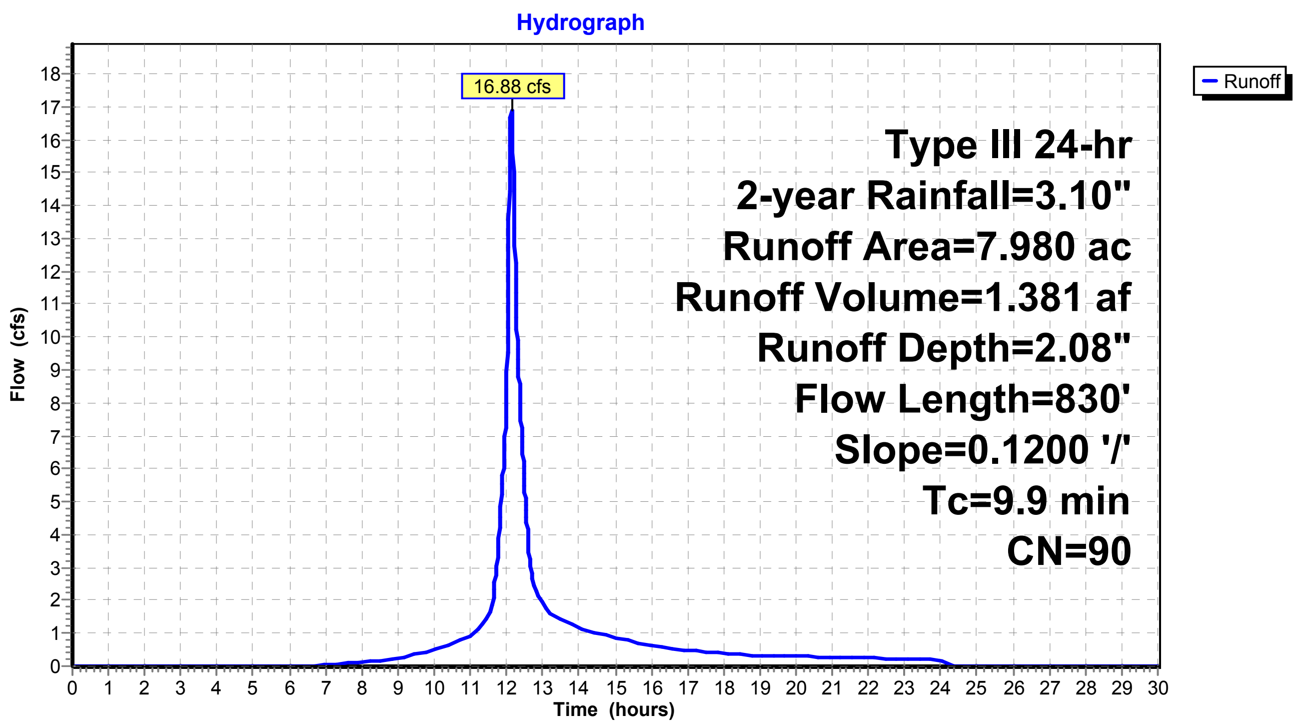
Runoff = 16.88 cfs @ 12.14 hrs, Volume= 1.381 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (ac)	CN	Description
2.210	98	Paved parking & roofs
2.531	98	Paved parking & roofs
0.470	73	Woods, Fair, HSG C
2.769	79	50-75% Grass cover, Fair, HSG C
7.980	90	Weighted Average
3.239		40.59% Pervious Area
4.741		59.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Parking**
0.8	400		8.00		**Direct Entry, Pipe**
4.1	430	0.1200	1.73		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps
9.9	830	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

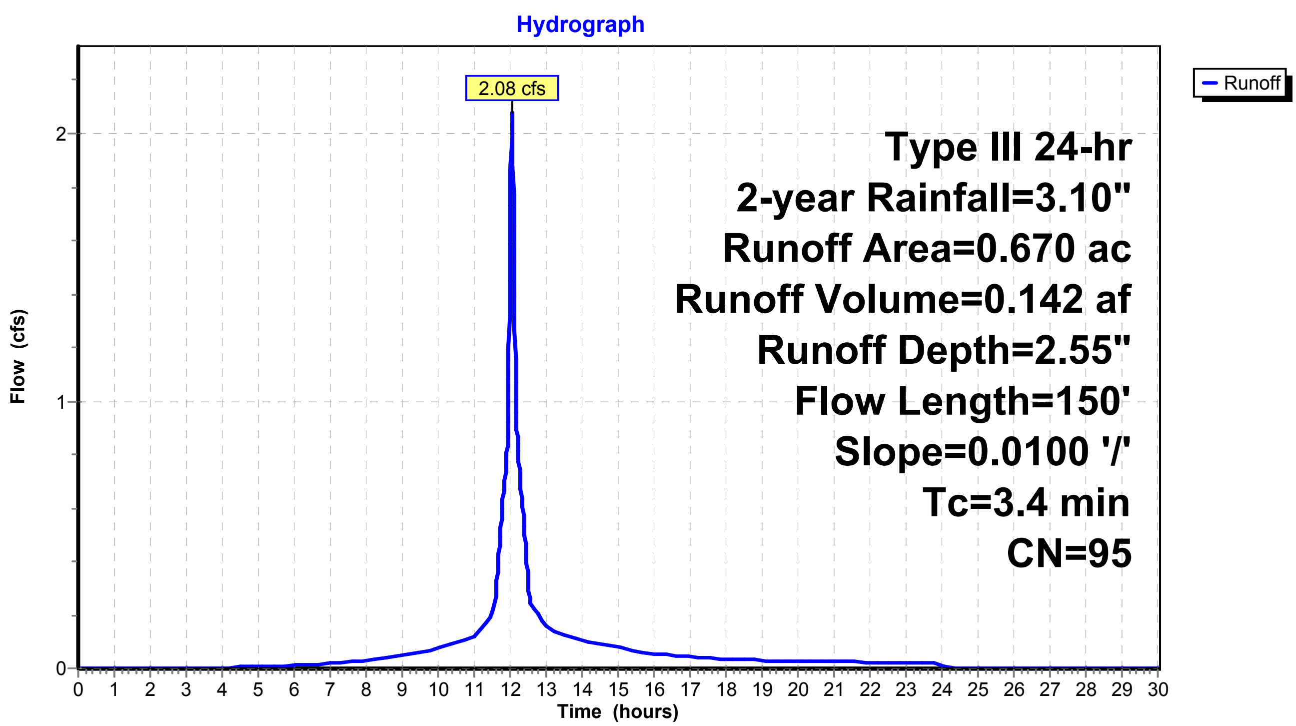
Runoff = 2.08 cfs @ 12.05 hrs, Volume= 0.142 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (ac)	CN	Description
0.420	98	Paved parking & roofs
0.130	98	Paved parking & roofs
0.120	79	50-75% Grass cover, Fair, HSG C
0.670	95	Weighted Average
0.120		17.91% Pervious Area
0.550		82.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	40	0.0100	0.87		**Sheet Flow, Section 1** Smooth surfaces n= 0.011 P2= 3.20"
2.6	110	0.0100	0.70		**Shallow Concentrated Flow, Channel** Short Grass Pasture Kv= 7.0 fps
3.4	150	Total			

Subcatchment S2: S2



Summary for Subcatchment S3: S3

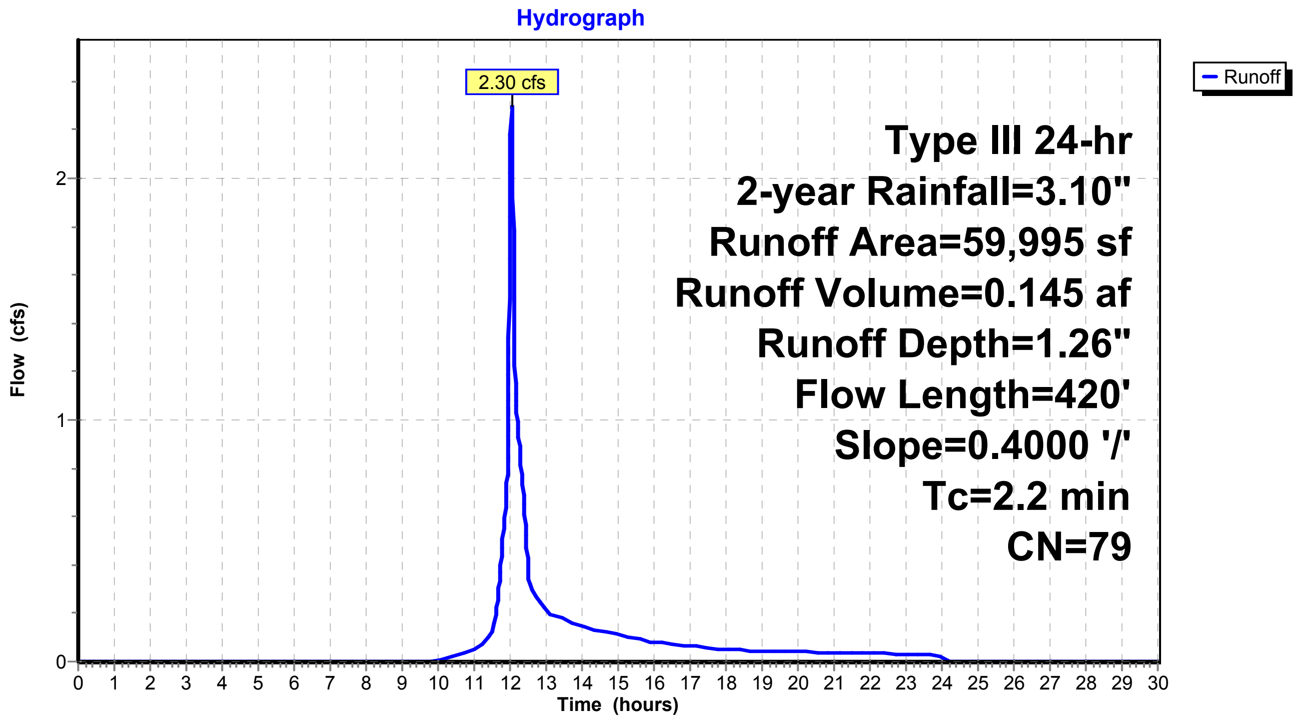
Runoff = 2.30 cfs @ 12.04 hrs, Volume= 0.145 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
6,534	73	Woods, Fair, HSG C
51,452	79	50-75% Grass cover, Fair, HSG C
2,009	98	Paved parking & roofs
59,995	79	Weighted Average
57,986		96.65% Pervious Area
2,009		3.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps

Subcatchment S3: S3

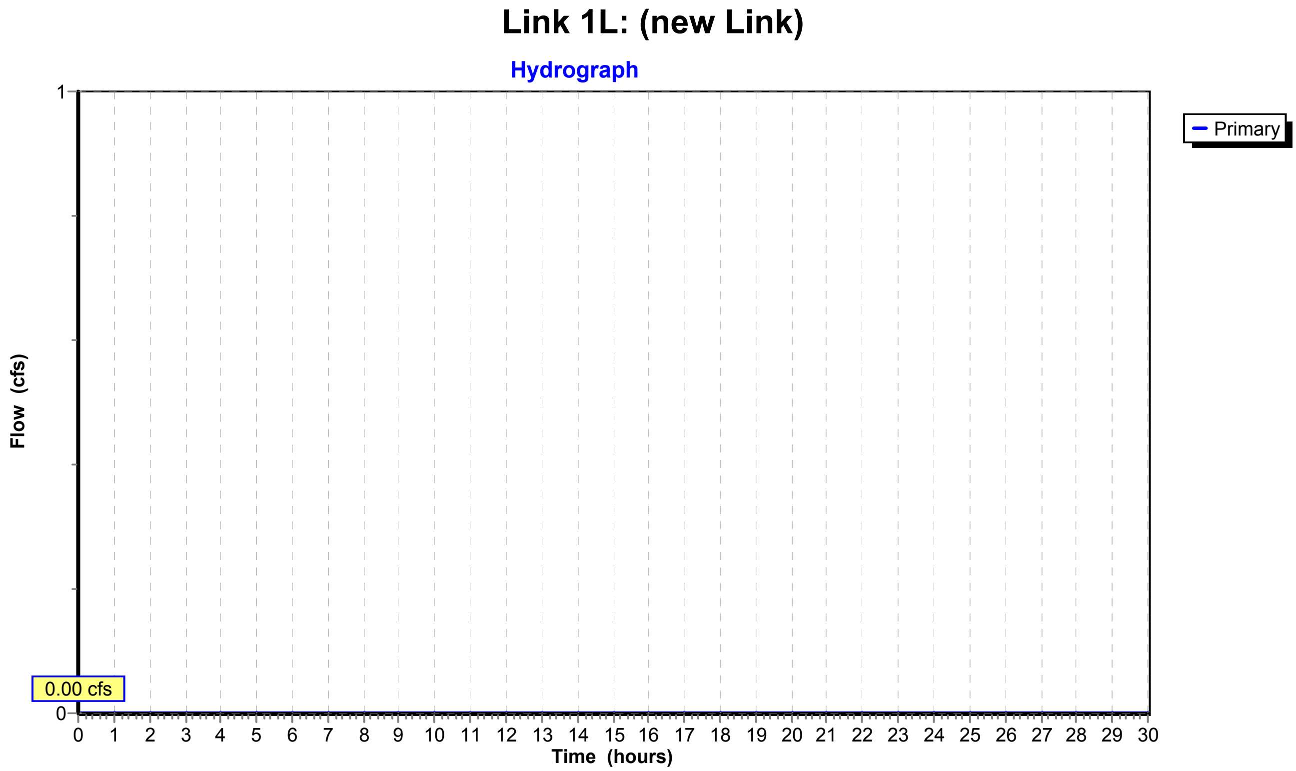


Summary for Link 1L: (new Link)

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentS1: S1 Runoff Area=7.980 ac 59.41% Impervious Runoff Depth=3.49"
Flow Length=830' Slope=0.1200 '/' Tc=9.9 min CN=90 Runoff=27.85 cfs 2.322 af

SubcatchmentS2: S2 Runoff Area=0.670 ac 82.09% Impervious Runoff Depth=4.02"
Flow Length=150' Slope=0.0100 '/' Tc=3.4 min CN=95 Runoff=3.20 cfs 0.225 af

SubcatchmentS3: S3 Runoff Area=59,995 sf 3.35% Impervious Runoff Depth=2.46"
Flow Length=420' Slope=0.4000 '/' Tc=2.2 min CN=79 Runoff=4.57 cfs 0.282 af

Link 1L: (new Link)
Primary=0.00 cfs 0.000 af

Total Runoff Area = 10.027 ac Runoff Volume = 2.829 af Average Runoff Depth = 3.39"
46.77% Pervious = 4.690 ac 53.23% Impervious = 5.337 ac

Summary for Subcatchment S1: S1

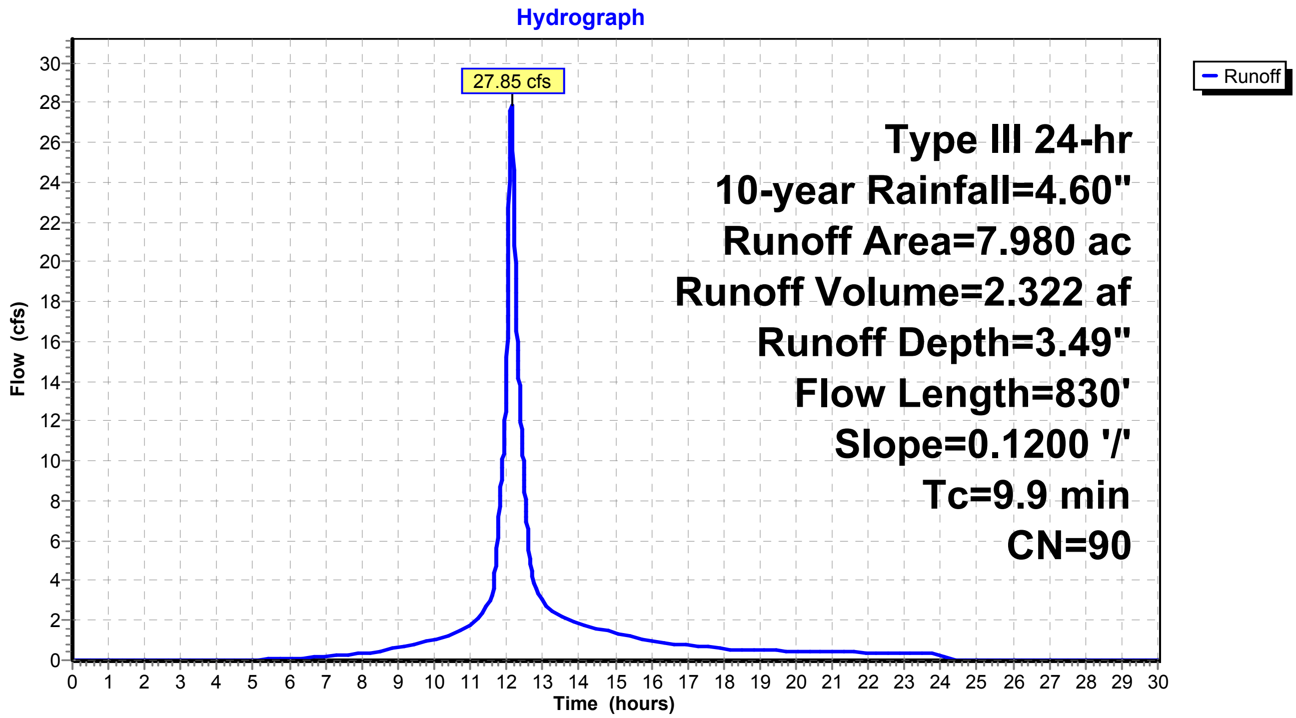
Runoff = 27.85 cfs @ 12.13 hrs, Volume= 2.322 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (ac)	CN	Description
2.210	98	Paved parking & roofs
2.531	98	Paved parking & roofs
0.470	73	Woods, Fair, HSG C
2.769	79	50-75% Grass cover, Fair, HSG C
7.980	90	Weighted Average
3.239		40.59% Pervious Area
4.741		59.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Parking**
0.8	400		8.00		**Direct Entry, Pipe**
4.1	430	0.1200	1.73		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps
9.9	830	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

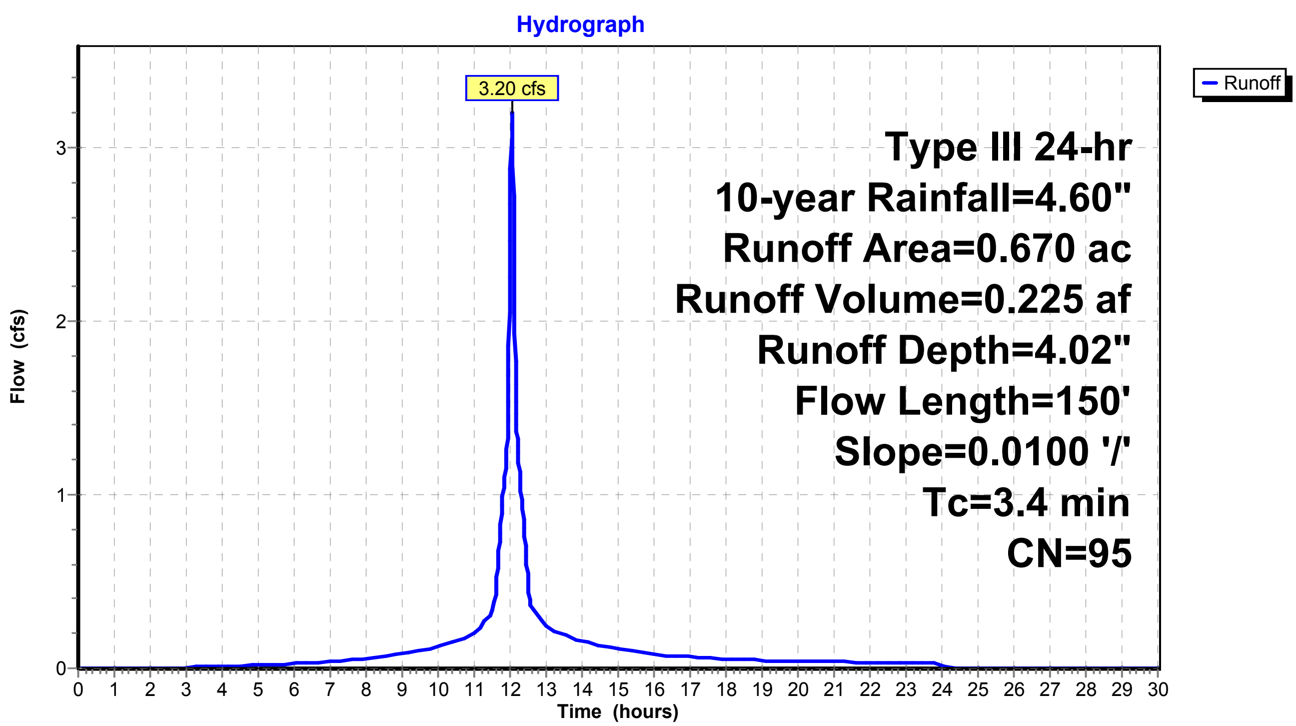
Runoff = 3.20 cfs @ 12.05 hrs, Volume= 0.225 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (ac)	CN	Description
0.420	98	Paved parking & roofs
0.130	98	Paved parking & roofs
0.120	79	50-75% Grass cover, Fair, HSG C
0.670	95	Weighted Average
0.120		17.91% Pervious Area
0.550		82.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	40	0.0100	0.87		**Sheet Flow, Section 1** Smooth surfaces n= 0.011 P2= 3.20"
2.6	110	0.0100	0.70		**Shallow Concentrated Flow, Channel** Short Grass Pasture Kv= 7.0 fps
3.4	150	Total			

Subcatchment S2: S2



Summary for Subcatchment S3: S3

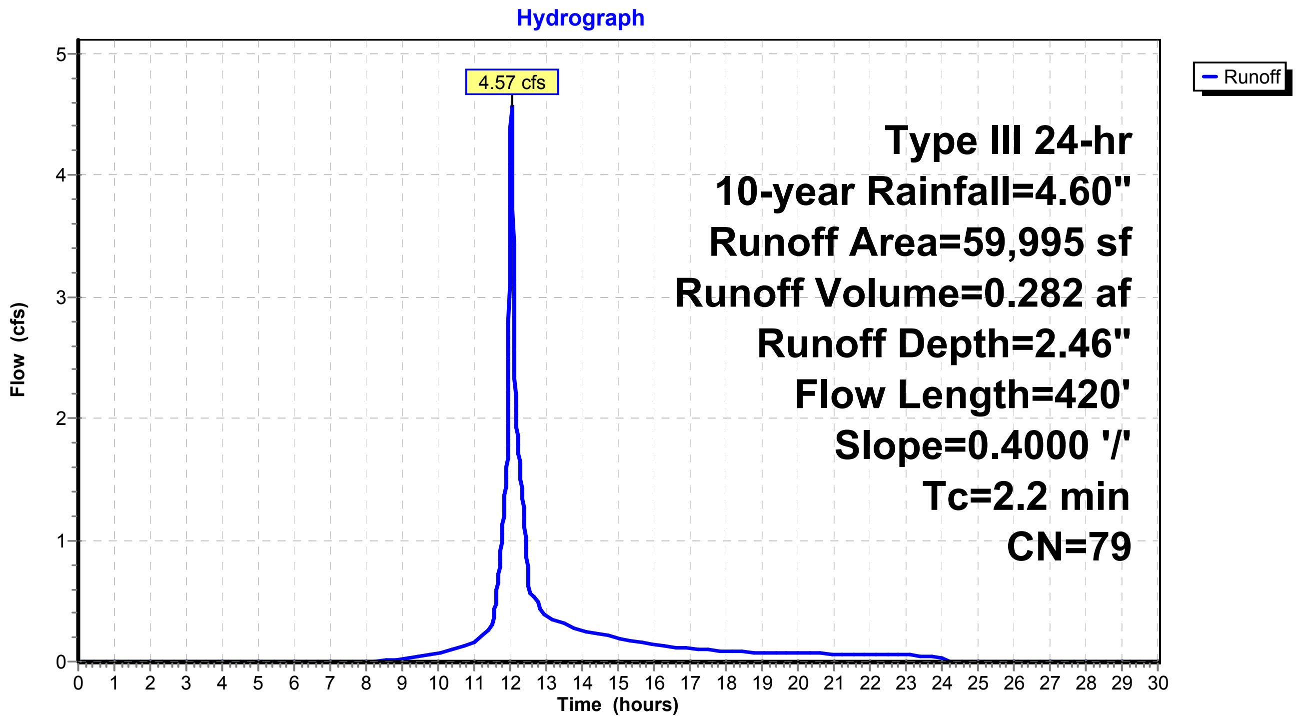
Runoff = 4.57 cfs @ 12.03 hrs, Volume= 0.282 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
6,534	73	Woods, Fair, HSG C
51,452	79	50-75% Grass cover, Fair, HSG C
2,009	98	Paved parking & roofs
59,995	79	Weighted Average
57,986		96.65% Pervious Area
2,009		3.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps

Subcatchment S3: S3



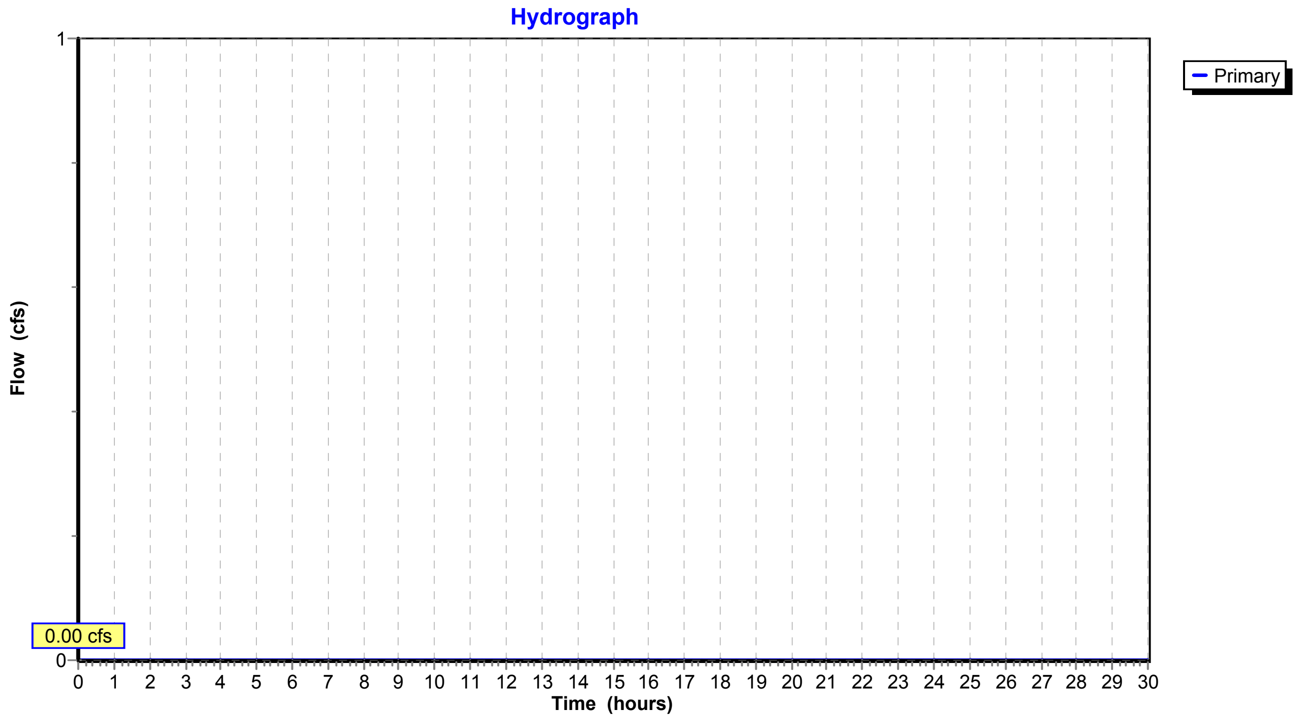
Summary for Link 1L: (new Link)

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 1L: (new Link)



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentS1: S1 Runoff Area=7.980 ac 59.41% Impervious Runoff Depth=4.36"
Flow Length=830' Slope=0.1200 '/' Tc=9.9 min CN=90 Runoff=34.39 cfs 2.899 af

SubcatchmentS2: S2 Runoff Area=0.670 ac 82.09% Impervious Runoff Depth=4.92"
Flow Length=150' Slope=0.0100 '/' Tc=3.4 min CN=95 Runoff=3.87 cfs 0.274 af

SubcatchmentS3: S3 Runoff Area=59,995 sf 3.35% Impervious Runoff Depth=3.24"
Flow Length=420' Slope=0.4000 '/' Tc=2.2 min CN=79 Runoff=6.00 cfs 0.371 af

Link 1L: (new Link)
Primary=0.00 cfs 0.000 af

Total Runoff Area = 10.027 ac Runoff Volume = 3.545 af Average Runoff Depth = 4.24"
46.77% Pervious = 4.690 ac 53.23% Impervious = 5.337 ac

Summary for Subcatchment S1: S1

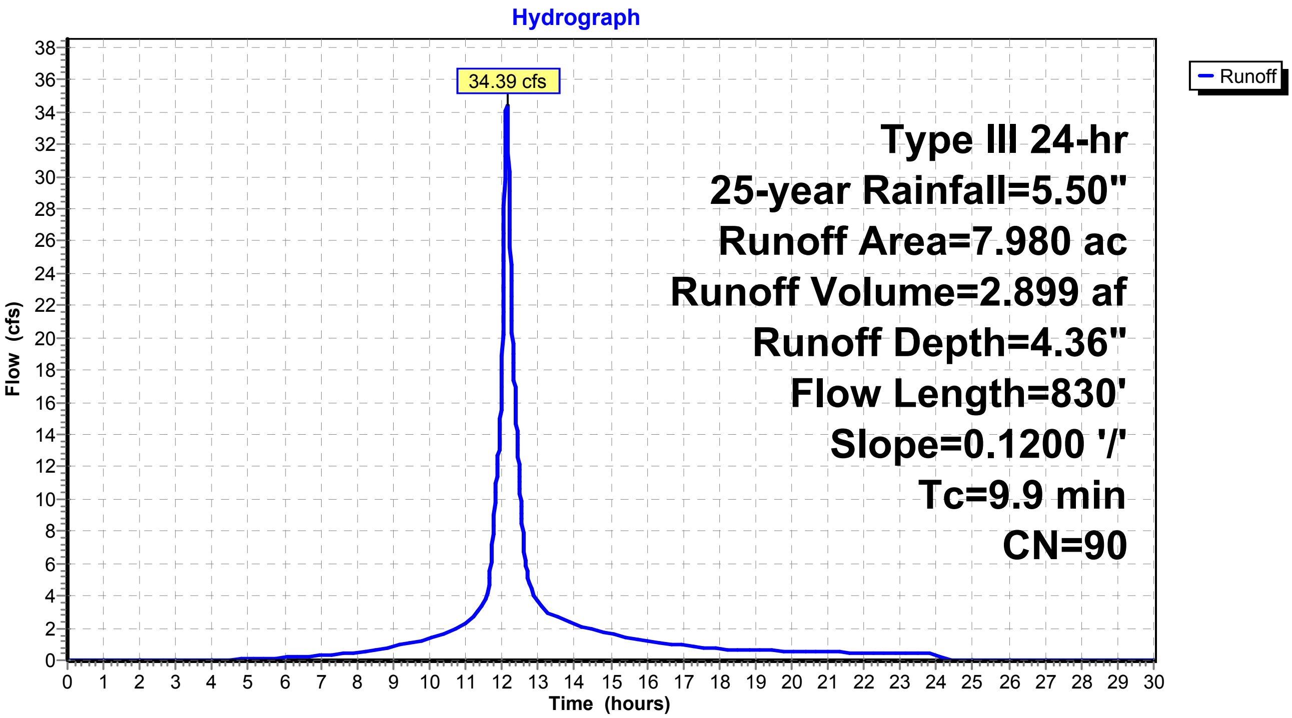
Runoff = 34.39 cfs @ 12.13 hrs, Volume= 2.899 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
2.210	98	Paved parking & roofs
2.531	98	Paved parking & roofs
0.470	73	Woods, Fair, HSG C
2.769	79	50-75% Grass cover, Fair, HSG C
7.980	90	Weighted Average
3.239		40.59% Pervious Area
4.741		59.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Parking**
0.8	400		8.00		**Direct Entry, Pipe**
4.1	430	0.1200	1.73		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps
9.9	830	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

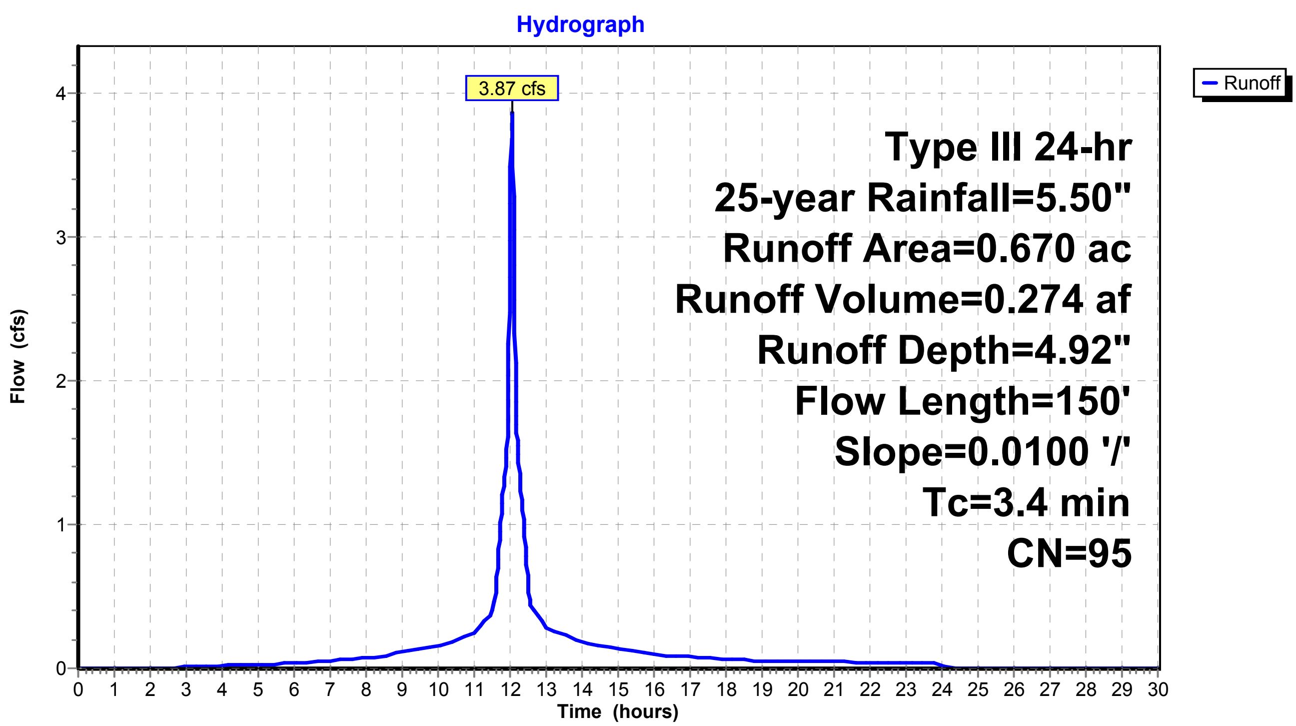
Runoff = 3.87 cfs @ 12.05 hrs, Volume= 0.274 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
0.420	98	Paved parking & roofs
0.130	98	Paved parking & roofs
0.120	79	50-75% Grass cover, Fair, HSG C
0.670	95	Weighted Average
0.120		17.91% Pervious Area
0.550		82.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	40	0.0100	0.87		**Sheet Flow, Section 1** Smooth surfaces n= 0.011 P2= 3.20"
2.6	110	0.0100	0.70		**Shallow Concentrated Flow, Channel** Short Grass Pasture Kv= 7.0 fps
3.4	150	Total			

Subcatchment S2: S2



Summary for Subcatchment S3: S3

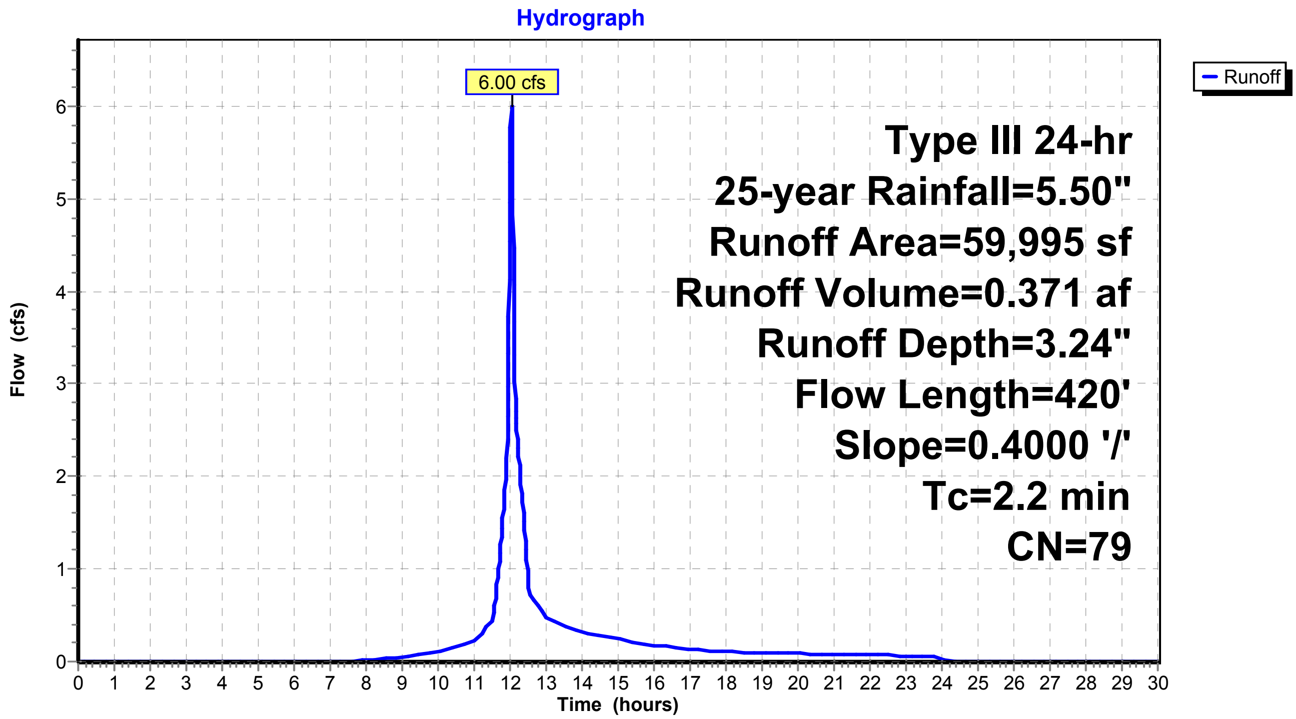
Runoff = 6.00 cfs @ 12.03 hrs, Volume= 0.371 af, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
6,534	73	Woods, Fair, HSG C
51,452	79	50-75% Grass cover, Fair, HSG C
2,009	98	Paved parking & roofs
59,995	79	Weighted Average
57,986		96.65% Pervious Area
2,009		3.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps

Subcatchment S3: S3



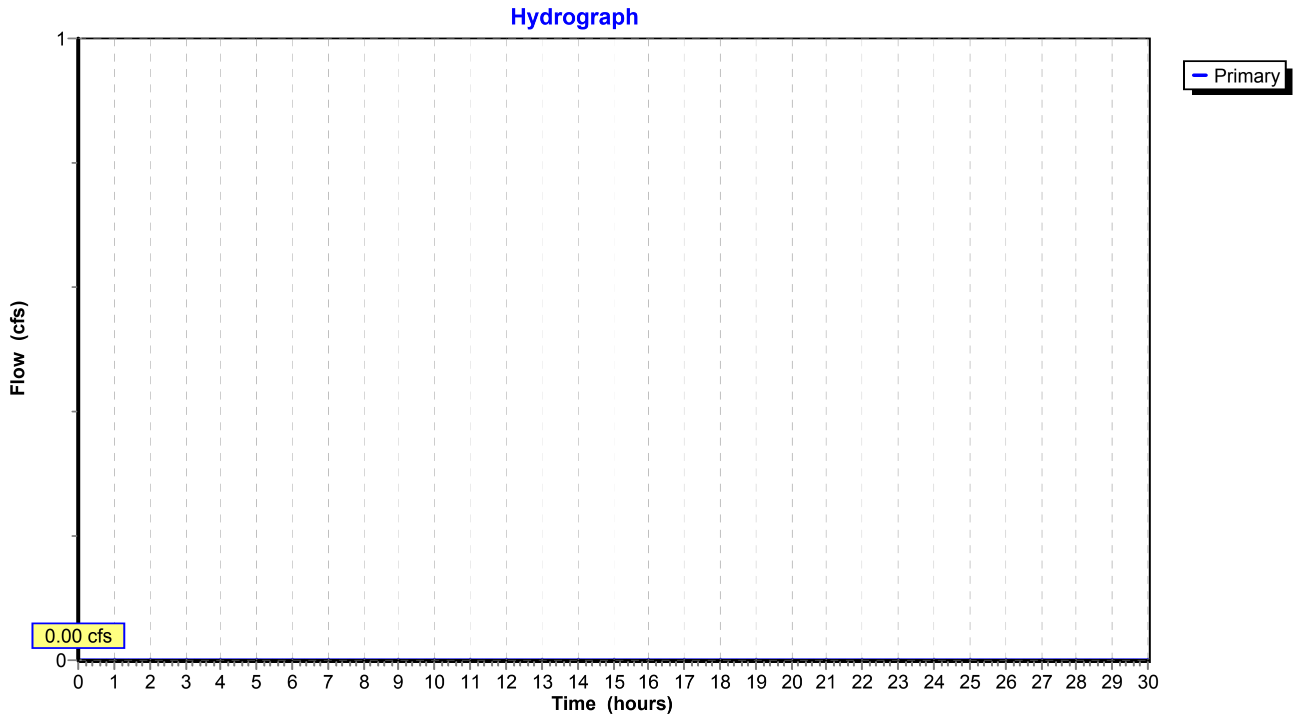
Summary for Link 1L: (new Link)

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 1L: (new Link)



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentS1: S1 Runoff Area=7.980 ac 59.41% Impervious Runoff Depth=5.43"
Flow Length=830' Slope=0.1200 '/' Tc=9.9 min CN=90 Runoff=42.34 cfs 3.612 af

SubcatchmentS2: S2 Runoff Area=0.670 ac 82.09% Impervious Runoff Depth=6.01"
Flow Length=150' Slope=0.0100 '/' Tc=3.4 min CN=95 Runoff=4.68 cfs 0.335 af

SubcatchmentS3: S3 Runoff Area=59,995 sf 3.35% Impervious Runoff Depth=4.22"
Flow Length=420' Slope=0.4000 '/' Tc=2.2 min CN=79 Runoff=7.78 cfs 0.484 af

Link 1L: (new Link)
Primary=0.00 cfs 0.000 af

Total Runoff Area = 10.027 ac Runoff Volume = 4.432 af Average Runoff Depth = 5.30"
46.77% Pervious = 4.690 ac 53.23% Impervious = 5.337 ac

Summary for Subcatchment S1: S1

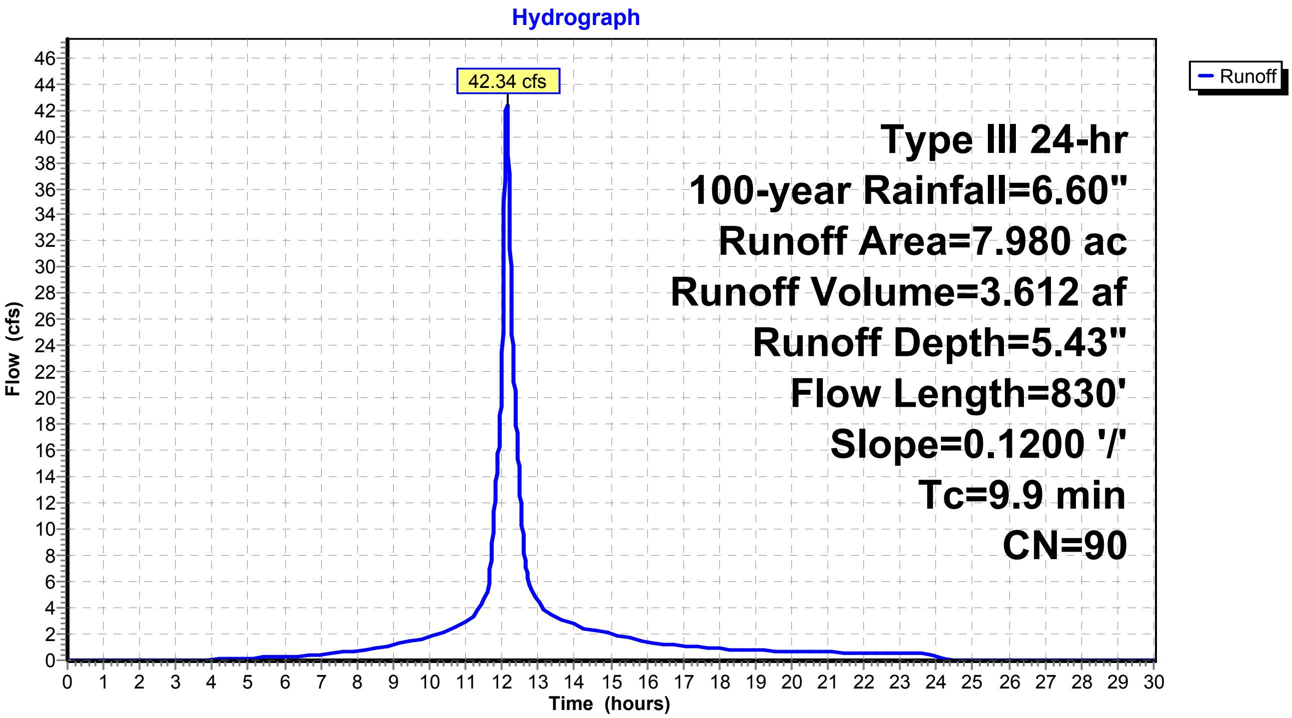
Runoff = 42.34 cfs @ 12.13 hrs, Volume= 3.612 af, Depth= 5.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (ac)	CN	Description
2.210	98	Paved parking & roofs
2.531	98	Paved parking & roofs
0.470	73	Woods, Fair, HSG C
2.769	79	50-75% Grass cover, Fair, HSG C
7.980	90	Weighted Average
3.239		40.59% Pervious Area
4.741		59.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Parking**
0.8	400		8.00		**Direct Entry, Pipe**
4.1	430	0.1200	1.73		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps
9.9	830	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

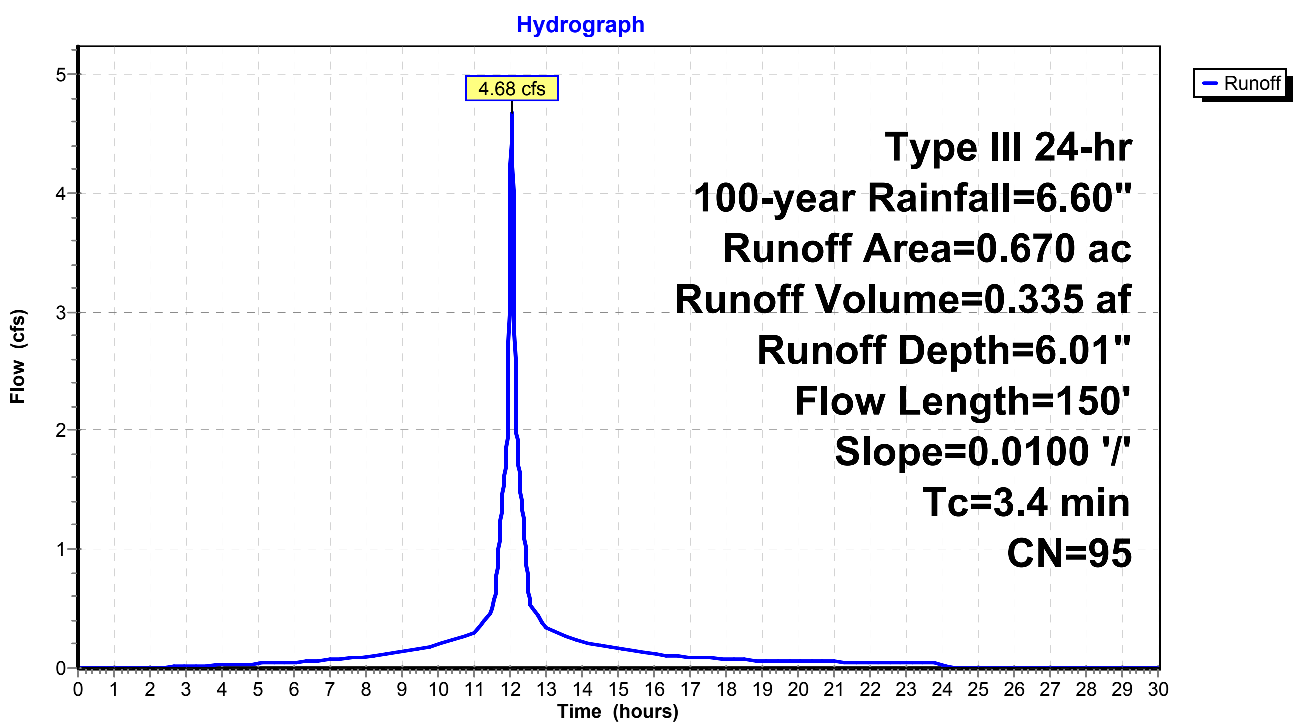
Runoff = 4.68 cfs @ 12.05 hrs, Volume= 0.335 af, Depth= 6.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (ac)	CN	Description
0.420	98	Paved parking & roofs
0.130	98	Paved parking & roofs
0.120	79	50-75% Grass cover, Fair, HSG C
0.670	95	Weighted Average
0.120		17.91% Pervious Area
0.550		82.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	40	0.0100	0.87		**Sheet Flow, Section 1** Smooth surfaces n= 0.011 P2= 3.20"
2.6	110	0.0100	0.70		**Shallow Concentrated Flow, Channel** Short Grass Pasture Kv= 7.0 fps
3.4	150	Total			

Subcatchment S2: S2



Summary for Subcatchment S3: S3

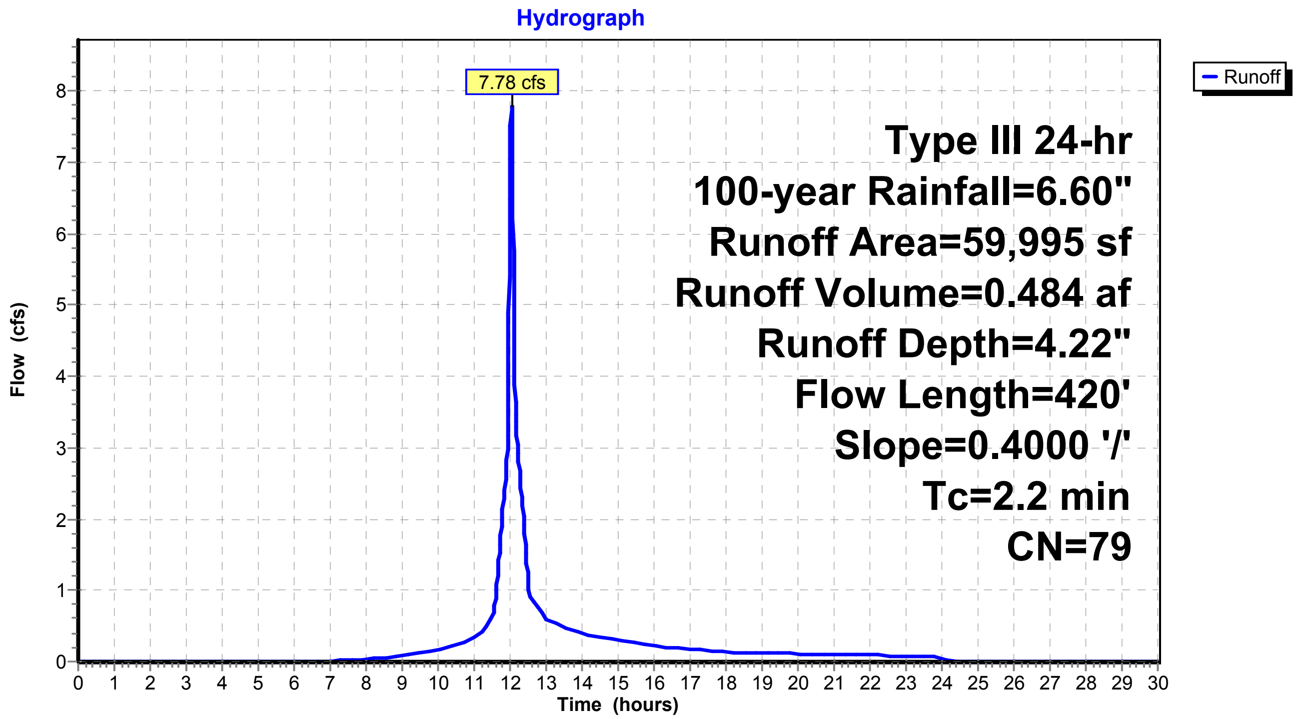
Runoff = 7.78 cfs @ 12.03 hrs, Volume= 0.484 af, Depth= 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
6,534	73	Woods, Fair, HSG C
51,452	79	50-75% Grass cover, Fair, HSG C
2,009	98	Paved parking & roofs
59,995	79	Weighted Average
57,986		96.65% Pervious Area
2,009		3.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Channel Flow** Woodland Kv= 5.0 fps

Subcatchment S3: S3



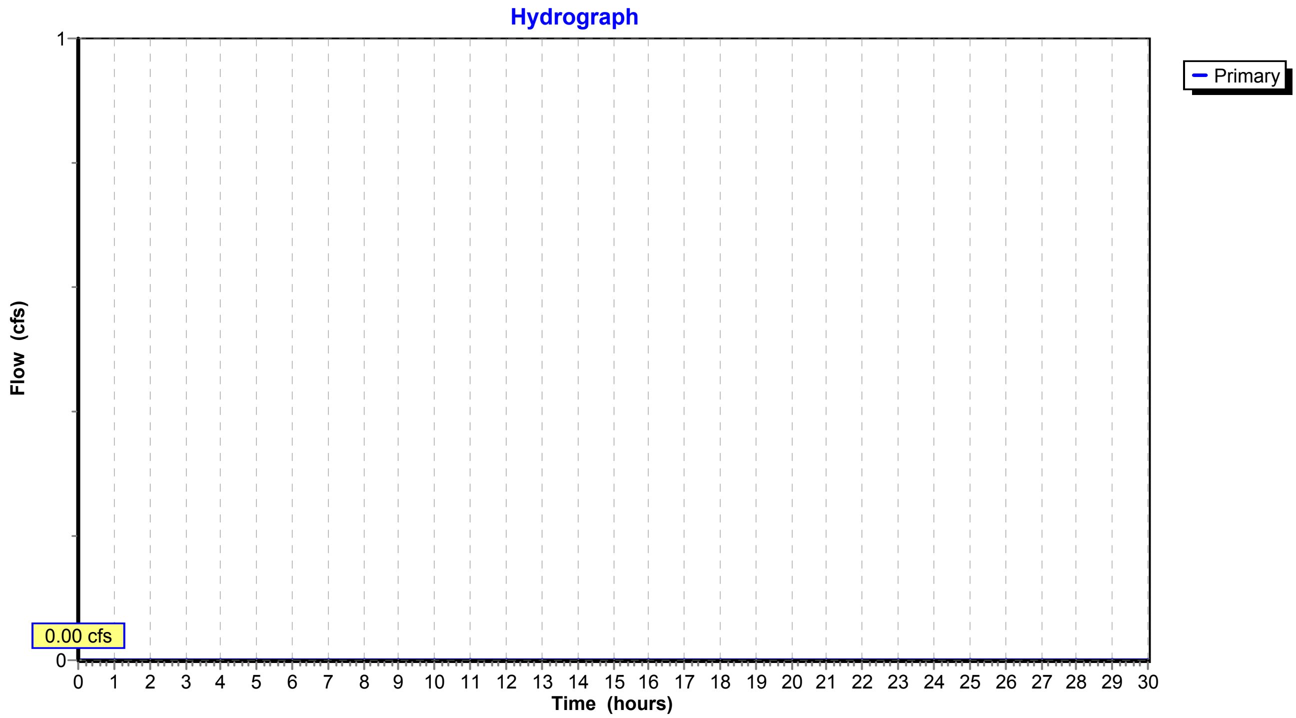
Summary for Link 1L: (new Link)

[43] Hint: Has no inflow (Outflow=Zero)

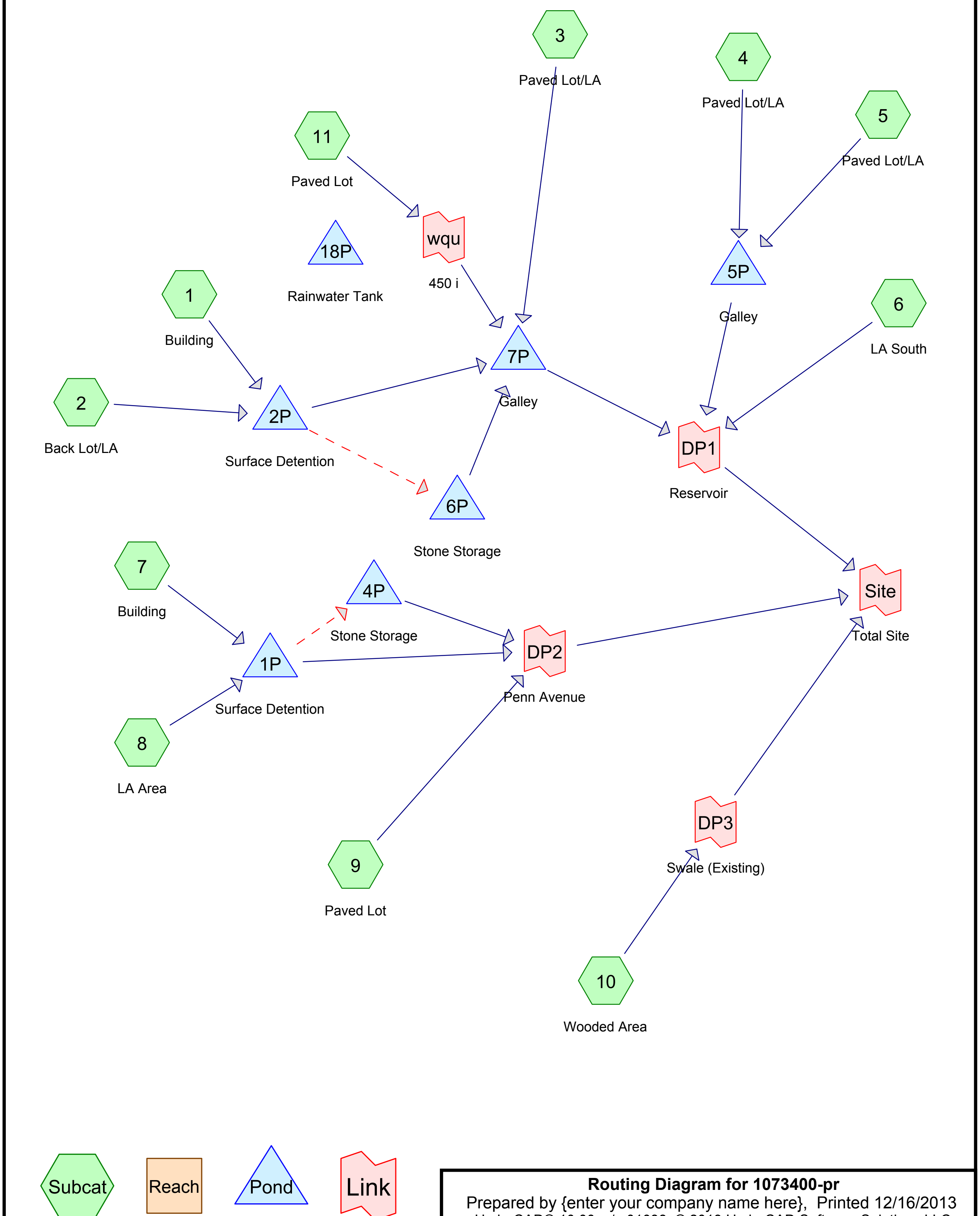
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 1L: (new Link)



HydroCAD Analysis: Proposed Conditions



Routing Diagram for 1073400-pr
Prepared by {enter your company name here}, Printed 12/16/2013
HydroCAD® 10.00 s/n 01038 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.425	74	>75% Grass cover, Good, HSG C (2, 3, 5, 6, 8, 9)
0.075	74	>75% Grass cover, Good, HSG C/Int LA (4)
0.280	74	>75% Grass cover, Good, HSG C/LA north (4)
0.093	98	Paved Driveway, HSG C (9)
3.773	98	Paved parking, HSG C (2, 3, 4, 5, 11)
1.924	98	Roofs, HSG C (1, 7)
1.437	73	Woods, Fair, HSG C (10)
10.007	**88**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Building Runoff Area=55,869 sf 100.00% Impervious Runoff Depth=2.87"
Tc=10.0 min CN=98 Runoff=3.38 cfs 0.307 af

Subcatchment2: Back Lot/LA Runoff Area=31,419 sf 67.58% Impervious Runoff Depth=2.08"
Tc=5.0 min CN=90 Runoff=1.80 cfs 0.125 af

Subcatchment3: Paved Lot/LA Runoff Area=44,557 sf 91.54% Impervious Runoff Depth=2.65"
Tc=5.0 min CN=96 Runoff=3.07 cfs 0.226 af

Subcatchment4: Paved Lot/LA Runoff Area=49,545 sf 68.78% Impervious Runoff Depth=2.16"
Tc=5.0 min CN=91 Runoff=2.95 cfs 0.205 af

Subcatchment5: Paved Lot/LA Runoff Area=65,440 sf 92.74% Impervious Runoff Depth=2.65"
Tc=5.0 min CN=96 Runoff=4.51 cfs 0.332 af

Subcatchment6: LA South Runoff Area=71,141 sf 0.00% Impervious Runoff Depth=0.97"
Flow Length=550' Tc=9.6 min CN=74 Runoff=1.54 cfs 0.132 af

Subcatchment7: Building Runoff Area=27,935 sf 100.00% Impervious Runoff Depth=2.87"
Tc=10.0 min CN=98 Runoff=1.69 cfs 0.153 af

Subcatchment8: LA Area Runoff Area=14,620 sf 0.00% Impervious Runoff Depth=0.97"
Flow Length=50' Slope=0.0100 '/' Tc=7.4 min CN=74 Runoff=0.34 cfs 0.027 af

Subcatchment9: Paved Lot Runoff Area=5,216 sf 77.76% Impervious Runoff Depth=2.35"
Tc=5.0 min CN=93 Runoff=0.33 cfs 0.023 af

Subcatchment10: Wooded Area Runoff Area=62,614 sf 0.00% Impervious Runoff Depth=0.92"
Flow Length=470' Tc=6.4 min CN=73 Runoff=1.42 cfs 0.110 af

Subcatchment11: Paved Lot Runoff Area=7,547 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=98 Runoff=0.54 cfs 0.041 af

Pond 1P: Surface Detention Peak Elev=255.00' Storage=2,115 cf Inflow=2.03 cfs 0.180 af
Primary=0.00 cfs 0.000 af Secondary=0.59 cfs 0.180 af Outflow=0.59 cfs 0.180 af

Pond 2P: Surface Detention Peak Elev=254.50' Storage=3,048 cf Inflow=4.92 cfs 0.431 af
Primary=1.60 cfs 0.045 af Secondary=2.02 cfs 0.387 af Outflow=3.62 cfs 0.431 af

Pond 4P: Stone Storage Peak Elev=250.50' Storage=2,491 cf Inflow=0.59 cfs 0.180 af
Discarded=0.07 cfs 0.121 af Primary=0.24 cfs 0.059 af Outflow=0.31 cfs 0.180 af

Pond 5P: Galley Peak Elev=228.62' Storage=3,778 cf Inflow=7.46 cfs 0.537 af
Discarded=0.02 cfs 0.073 af Primary=7.39 cfs 0.448 af Outflow=7.41 cfs 0.521 af

Pond 6P: Stone Storage Peak Elev=251.63' Storage=2,477 cf Inflow=2.02 cfs 0.387 af
Discarded=0.05 cfs 0.133 af Primary=1.89 cfs 0.229 af Outflow=1.94 cfs 0.361 af

Pond 7P: Galley
Peak Elev=251.24' Storage=0.146 af Inflow=5.80 cfs 0.541 af
Discarded=0.03 cfs 0.119 af Primary=5.50 cfs 0.384 af Outflow=5.53 cfs 0.504 af

Pond 18P: Rainwater Tank
Peak Elev=0.00' Storage=0.000 af
Primary=0.00 cfs 0.000 af

Link DP1: Reservoir
Inflow=12.40 cfs 0.964 af
Primary=12.40 cfs 0.964 af

Link DP2: Penn Avenue
Inflow=0.33 cfs 0.083 af
Primary=0.33 cfs 0.083 af

Link DP3: Swale (Existing)
Inflow=1.42 cfs 0.110 af
Primary=1.42 cfs 0.110 af

Link Site: Total Site
Inflow=13.84 cfs 1.157 af
Primary=13.84 cfs 1.157 af

Link wqu: 450 i
Inflow=0.54 cfs 0.041 af
Primary=0.54 cfs 0.041 af

Total Runoff Area = 10.007 ac Runoff Volume = 1.682 af Average Runoff Depth = 2.02"
42.14% Pervious = 4.217 ac 57.86% Impervious = 5.790 ac

Summary for Subcatchment 1: Building

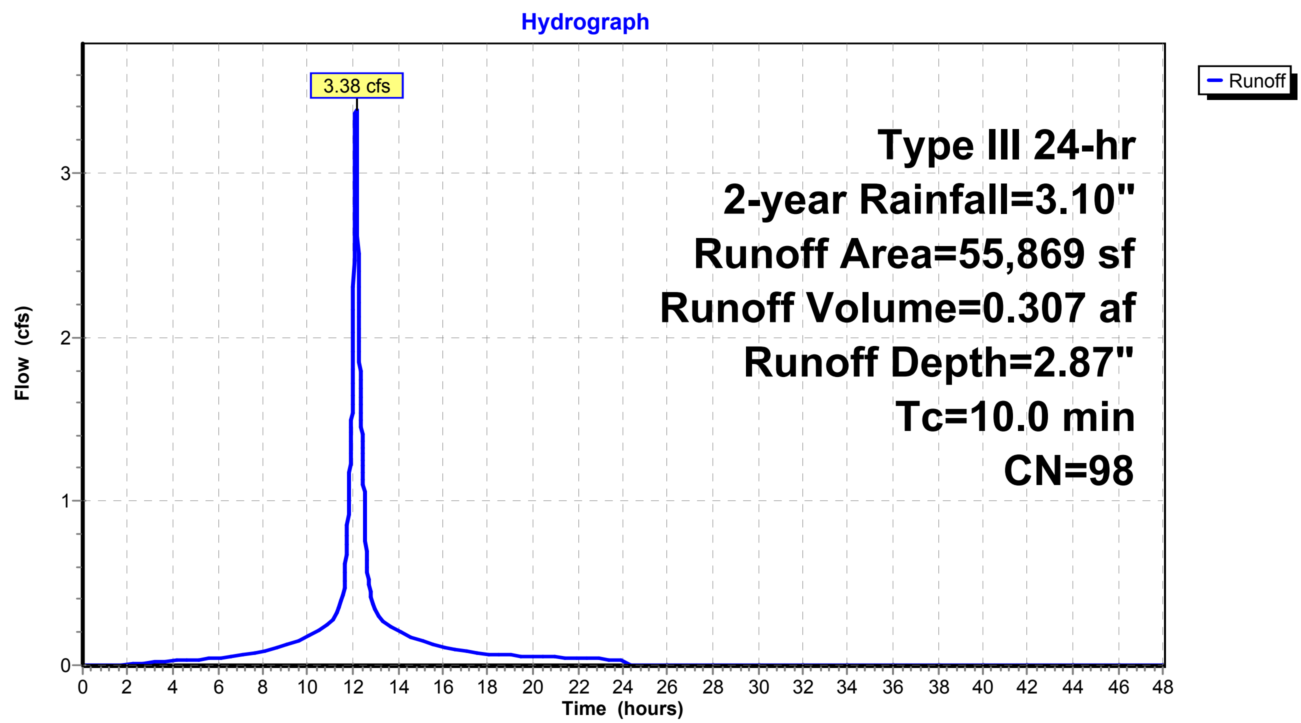
Runoff = 3.38 cfs @ 12.13 hrs, Volume= 0.307 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
55,869	98	Roofs, HSG C
55,869		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1: Building



Summary for Subcatchment 2: Back Lot/LA

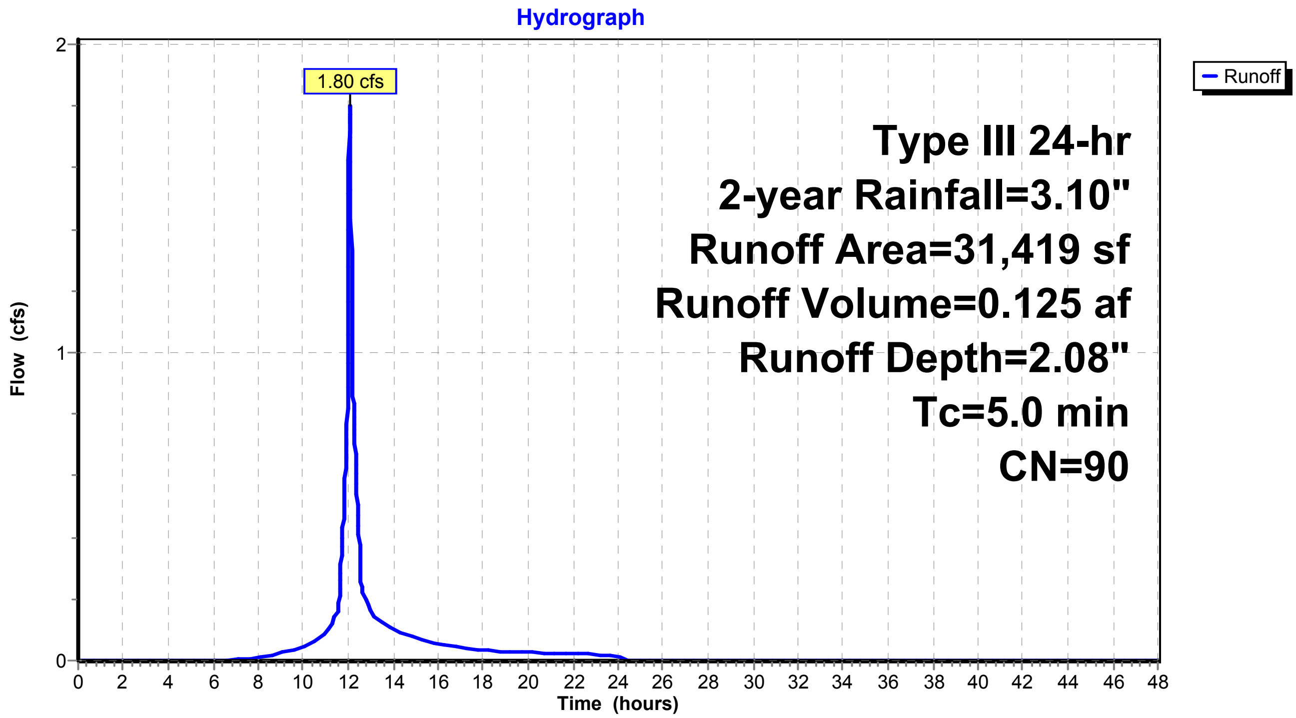
Runoff = 1.80 cfs @ 12.07 hrs, Volume= 0.125 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
21,234	98	Paved parking, HSG C
10,185	74	>75% Grass cover, Good, HSG C
31,419	90	Weighted Average
10,185		32.42% Pervious Area
21,234		67.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Back Lot/LA



Summary for Subcatchment 3: Paved Lot/LA

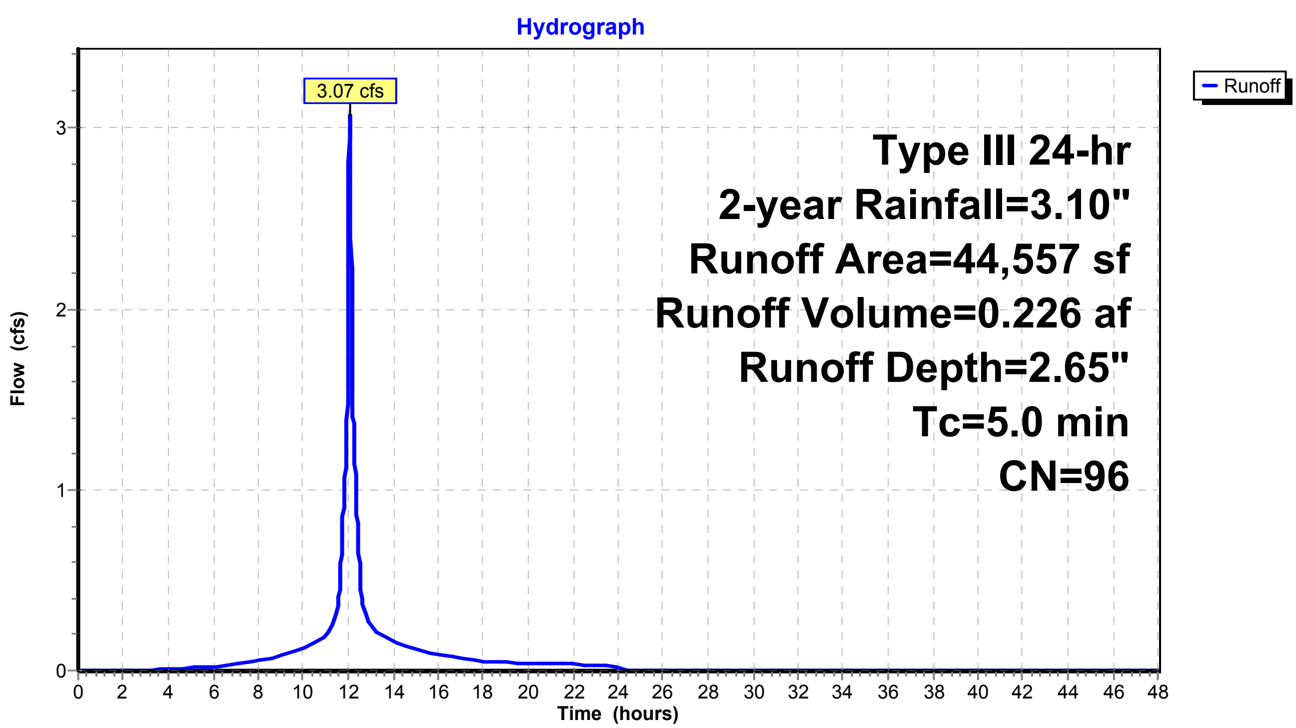
Runoff = 3.07 cfs @ 12.07 hrs, Volume= 0.226 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
40,788	98	Paved parking, HSG C
3,769	74	>75% Grass cover, Good, HSG C
44,557	96	Weighted Average
3,769		8.46% Pervious Area
40,788		91.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Paved Lot/LA



Summary for Subcatchment 4: Paved Lot/LA

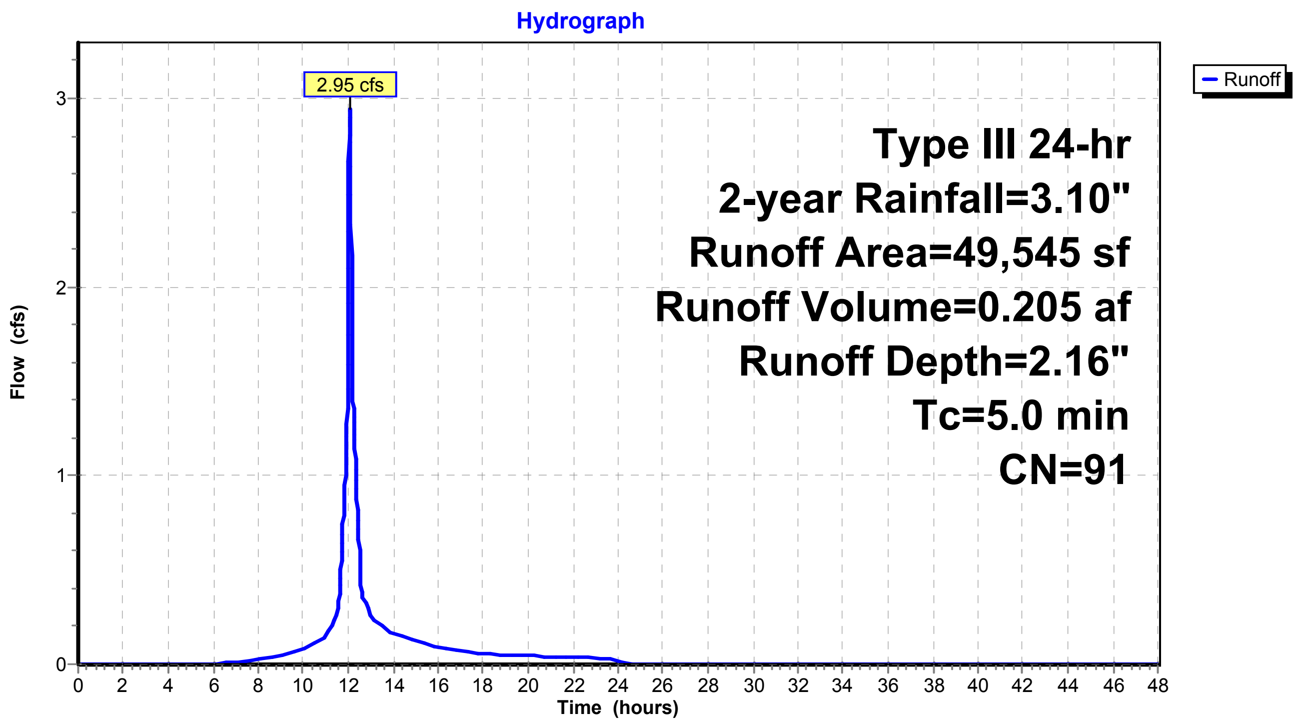
Runoff = 2.95 cfs @ 12.07 hrs, Volume= 0.205 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

	Area (sf)	CN	Description
	34,076	98	Paved parking, HSG C
*	3,279	74	>75% Grass cover, Good, HSG C/Int LA
*	12,190	74	>75% Grass cover, Good, HSG C/LA north
	49,545	91	Weighted Average
	15,469		31.22% Pervious Area
	34,076		68.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Paved Lot/LA



Summary for Subcatchment 5: Paved Lot/LA

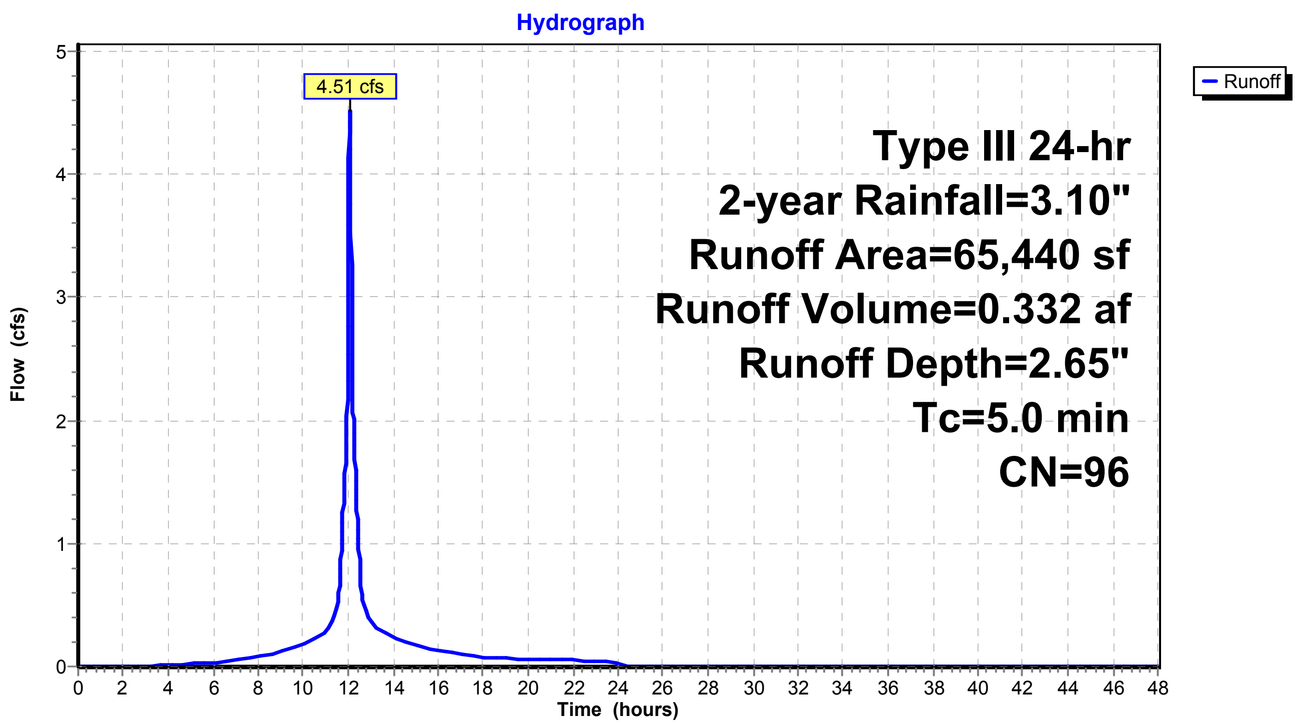
Runoff = 4.51 cfs @ 12.07 hrs, Volume= 0.332 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
60,688	98	Paved parking, HSG C
4,752	74	>75% Grass cover, Good, HSG C
65,440	96	Weighted Average
4,752		7.26% Pervious Area
60,688		92.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Paved Lot/LA



Summary for Subcatchment 6: LA South

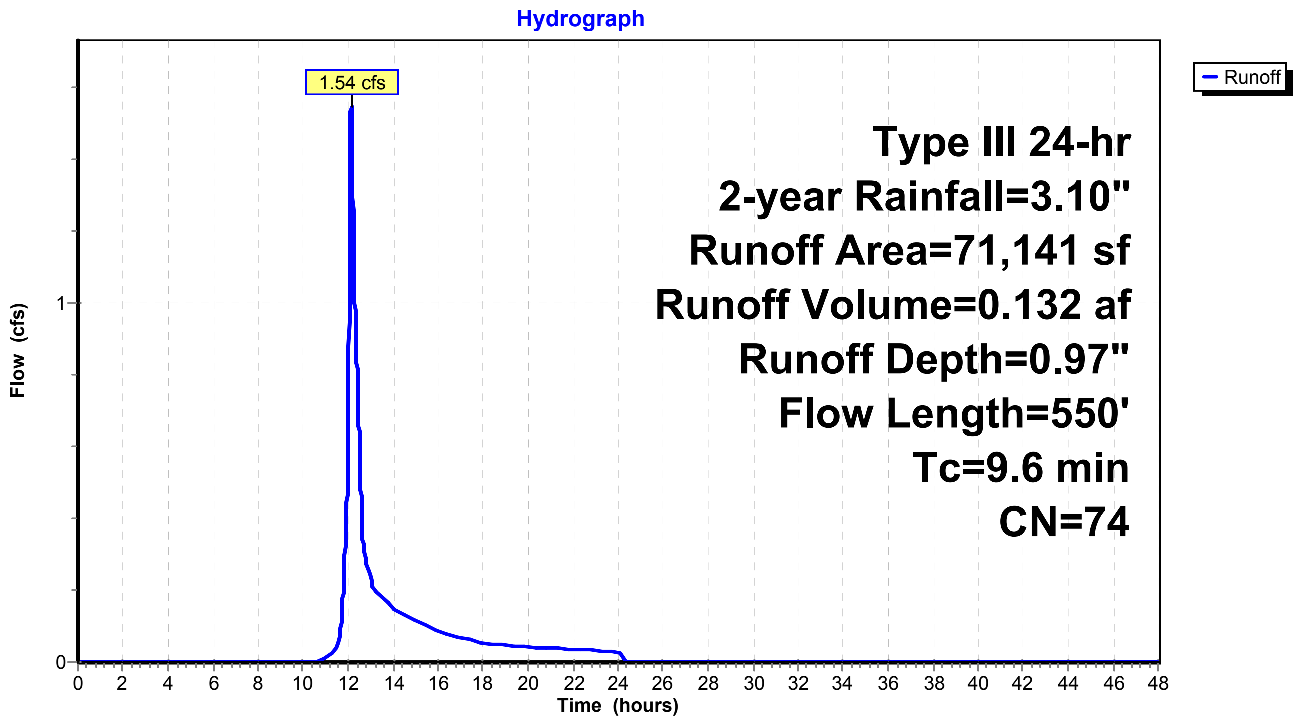
Runoff = 1.54 cfs @ 12.15 hrs, Volume= 0.132 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
71,141	74	>75% Grass cover, Good, HSG C
71,141		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	50	0.1000	0.28		**Sheet Flow, Grass/Wooded Area** Grass: Short n= 0.150 P2= 3.20"
6.0	400	0.0500	1.12		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
0.6	100	0.3000	2.74		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
9.6	550	Total			

Subcatchment 6: LA South



Summary for Subcatchment 7: Building

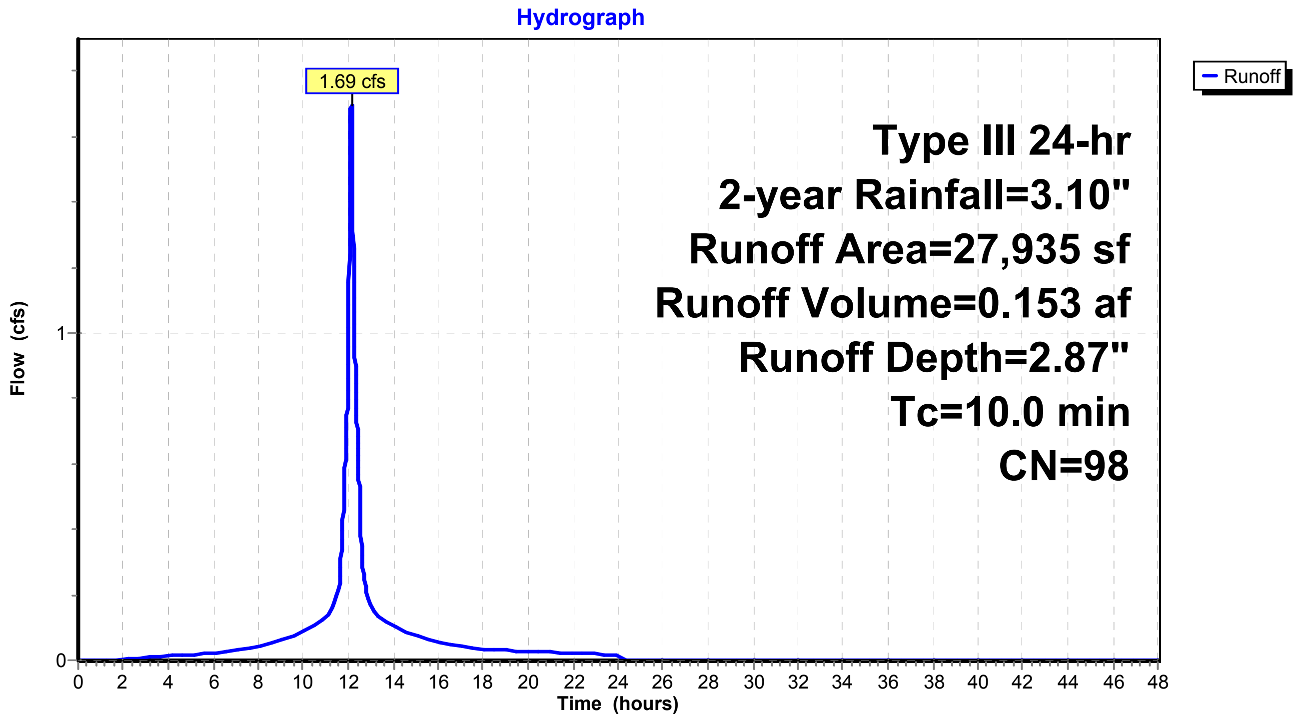
Runoff = 1.69 cfs @ 12.13 hrs, Volume= 0.153 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
27,935	98	Roofs, HSG C
27,935		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 7: Building



Summary for Subcatchment 8: LA Area

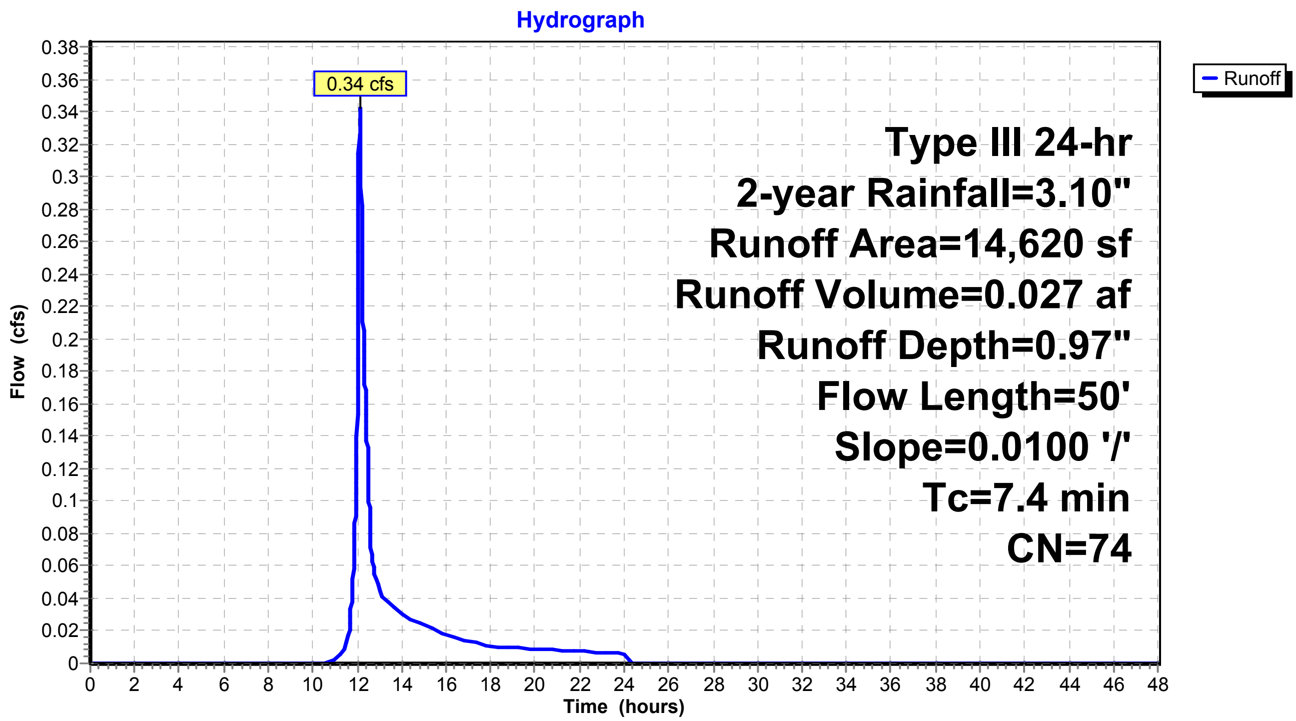
Runoff = 0.34 cfs @ 12.11 hrs, Volume= 0.027 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
14,620	74	>75% Grass cover, Good, HSG C
14,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, Grass Area** Grass: Short n= 0.150 P2= 3.20"

Subcatchment 8: LA Area



Summary for Subcatchment 9: Paved Lot

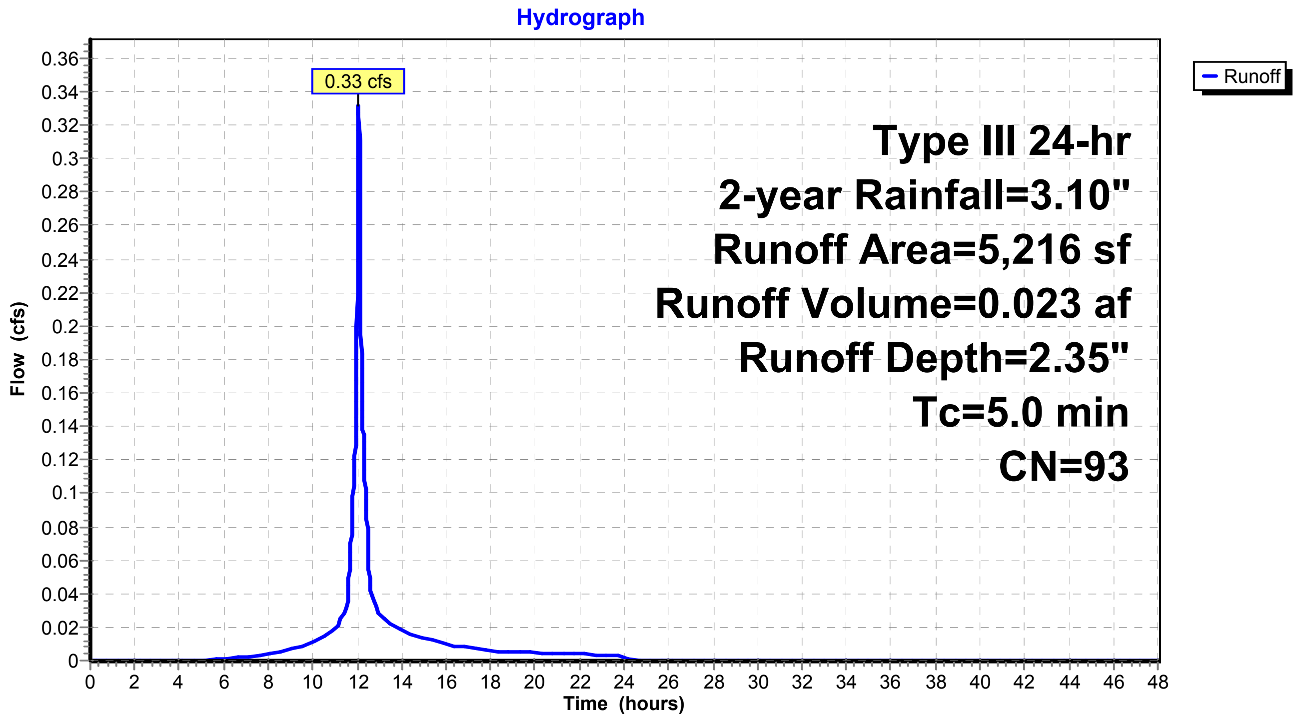
Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.023 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

	Area (sf)	CN	Description
*	4,056	98	Paved Driveway, HSG C
	1,160	74	>75% Grass cover, Good, HSG C
	5,216	93	Weighted Average
	1,160		22.24% Pervious Area
	4,056		77.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9: Paved Lot



Summary for Subcatchment 10: Wooded Area

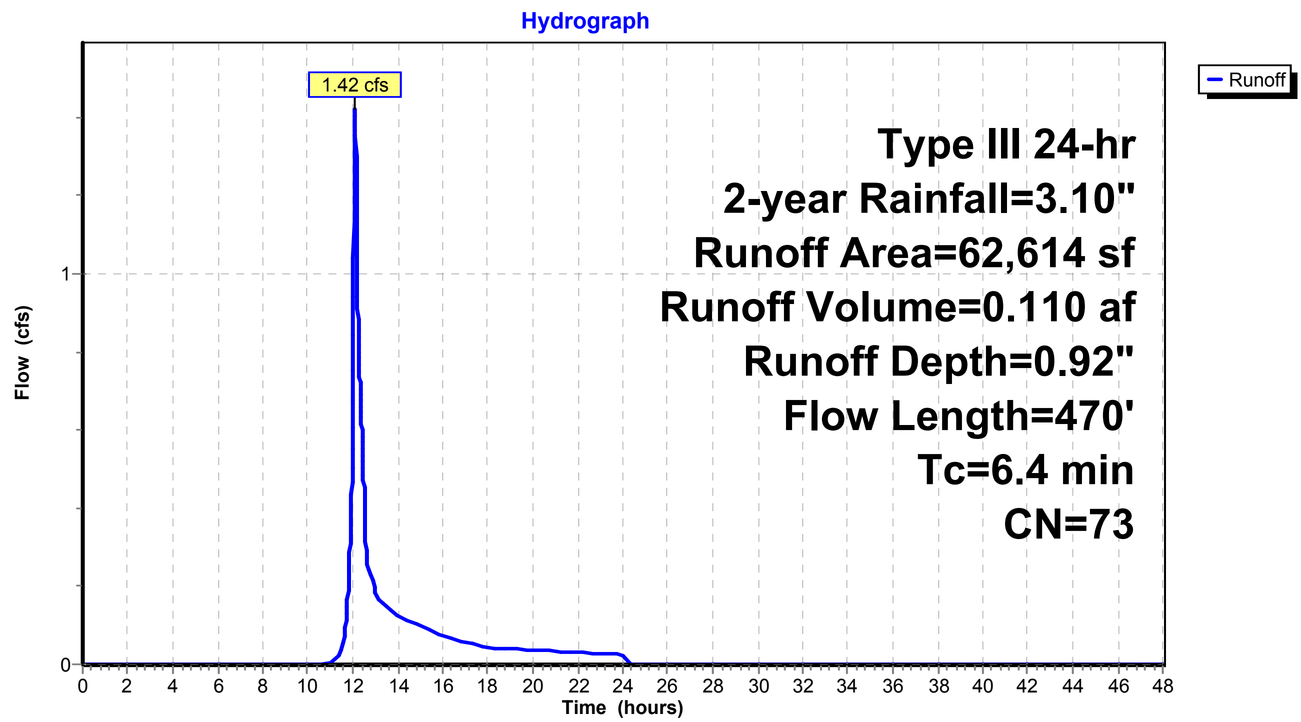
Runoff = 1.42 cfs @ 12.10 hrs, Volume= 0.110 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
62,614	73	Woods, Fair, HSG C
62,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.3000	0.20		**Sheet Flow, Wooded Area** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
6.4	470	Total			

Subcatchment 10: Wooded Area



Summary for Subcatchment 11: Paved Lot

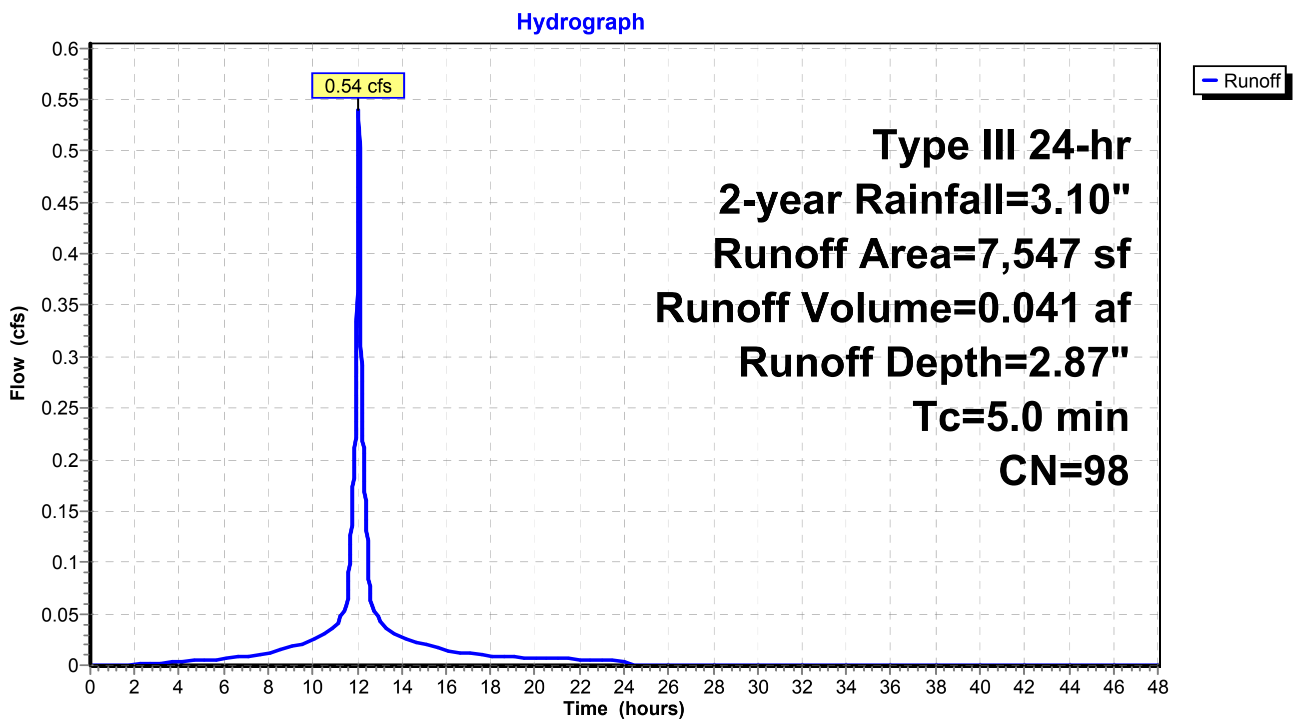
Runoff = 0.54 cfs @ 12.07 hrs, Volume= 0.041 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
7,547	98	Paved parking, HSG C
7,547		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11: Paved Lot



Summary for Pond 1P: Surface Detention

Inflow Area = 0.977 ac, 65.64% Impervious, Inflow Depth = 2.22" for 2-year event
Inflow = 2.03 cfs @ 12.13 hrs, Volume= 0.180 af
Outflow = 0.59 cfs @ 12.52 hrs, Volume= 0.180 af, Atten= 71%, Lag= 23.1 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.59 cfs @ 12.52 hrs, Volume= 0.180 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 255.00' @ 12.52 hrs Surf.Area= 2,758 sf Storage= 2,115 cf
Flood Elev= 257.00' Surf.Area= 5,368 sf Storage= 10,203 cf

Plug-Flow detention time= 34.6 min calculated for 0.180 af (100% of inflow)
Center-of-Mass det. time= 34.5 min (811.1 - 776.5)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	10,203 cf	**Surface Detention (Irregular)** Listed below (Recalc)

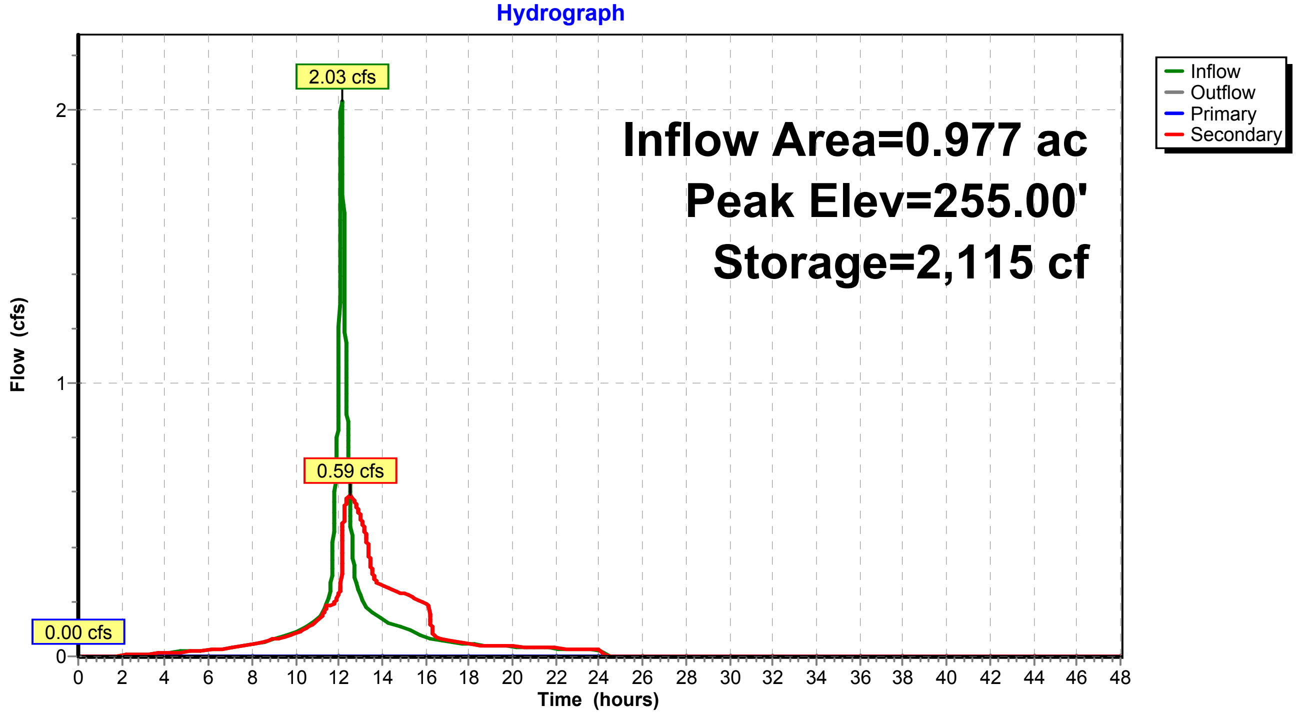
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
254.00	1,548	396.2	0	0	1,548
255.00	2,764	415.0	2,127	2,127	2,828
256.00	4,038	433.9	3,381	5,508	4,173
256.50	4,696	443.3	2,181	7,689	4,865
257.00	5,368	452.7	2,514	10,203	5,572

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	255.25'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	254.60'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	254.00'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=254.00' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.59 cfs @ 12.52 hrs HW=255.00' (Free Discharge)
3=Orifice/Grate (Orifice Controls 0.26 cfs @ 3.03 fps)
4=Exfiltration (Exfiltration Controls 0.33 cfs)

Pond 1P: Surface Detention



Summary for Pond 2P: Surface Detention

Inflow Area = 2.004 ac, 88.33% Impervious, Inflow Depth = 2.58" for 2-year event
Inflow = 4.92 cfs @ 12.11 hrs, Volume= 0.431 af
Outflow = 3.62 cfs @ 12.21 hrs, Volume= 0.431 af, Atten= 26%, Lag= 6.2 min
Primary = 1.60 cfs @ 12.21 hrs, Volume= 0.045 af
Secondary = 2.02 cfs @ 12.21 hrs, Volume= 0.387 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 254.50' @ 12.21 hrs Surf.Area= 3,594 sf Storage= 3,048 cf

Plug-Flow detention time= 16.5 min calculated for 0.431 af (100% of inflow)
Center-of-Mass det. time= 16.5 min (790.7 - 774.2)

Volume	Invert	Avail.Storage	Storage Description
#1	253.50'	9,744 cf	**Surface Detention (Irregular)** Listed below (Recalc)

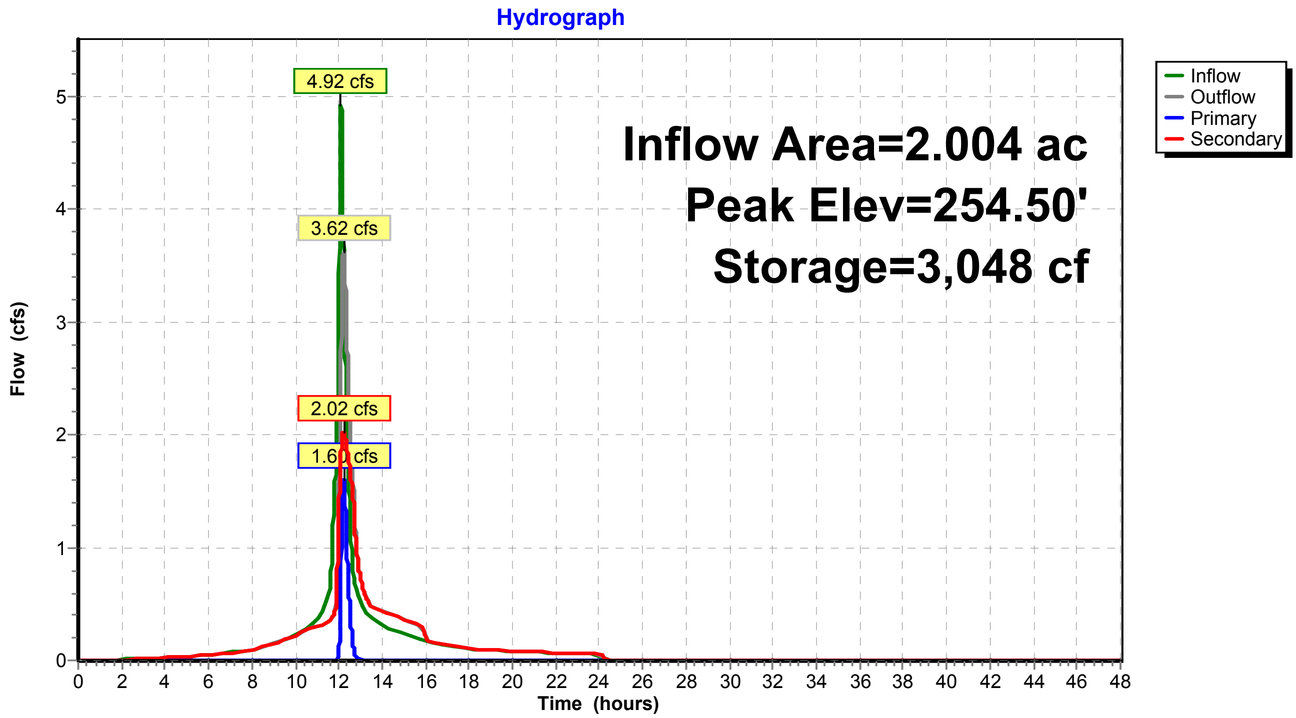
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.50	2,486	280.0	0	0	2,486
254.00	3,039	317.8	1,379	1,379	4,290
255.00	4,186	386.5	3,597	4,976	8,157
256.00	5,374	405.3	4,768	9,744	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	254.33'	**18.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	254.16'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	254.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	253.90'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	253.50'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=1.60 cfs @ 12.21 hrs HW=254.50' (Free Discharge)
—**1=Orifice/Grate** (Controls 0.00 cfs)
—**2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 1.42 fps)
—**3=Orifice/Grate** (Orifice Controls 0.48 cfs @ 2.00 fps)
—**4=Orifice/Grate** (Orifice Controls 0.96 cfs @ 2.42 fps)

Secondary OutFlow Max=2.02 cfs @ 12.21 hrs HW=254.50' (Free Discharge)
—**5=Orifice/Grate** (Orifice Controls 1.31 cfs @ 3.74 fps)
—**6=Exfiltration** (Exfiltration Controls 0.71 cfs)

Pond 2P: Surface Detention



Summary for Pond 4P: Stone Storage

Inflow	=	0.59 cfs @	12.52 hrs, Volume=	0.180 af
Outflow	=	0.31 cfs @	13.54 hrs, Volume=	0.180 af, Atten= 47%, Lag= 61.2 min
Discarded	=	0.07 cfs @	13.54 hrs, Volume=	0.121 af
Primary	=	0.24 cfs @	13.54 hrs, Volume=	0.059 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 250.50' @ 13.54 hrs Surf.Area= 3,771 sf Storage= 2,491 cf

Plug-Flow detention time= 199.2 min calculated for 0.180 af (100% of inflow)
Center-of-Mass det. time= 199.2 min (1,010.3 - 811.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	250.50'	583 cf	**ADS N-12 12** x 36 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	4,367 cf	**20.84'W x 181.00'L x 3.71'H Field A** 13,987 cf Overall - 754 cf Embedded = 13,233 cf x 33.0% Voids
		4,950 cf	Total Available Storage

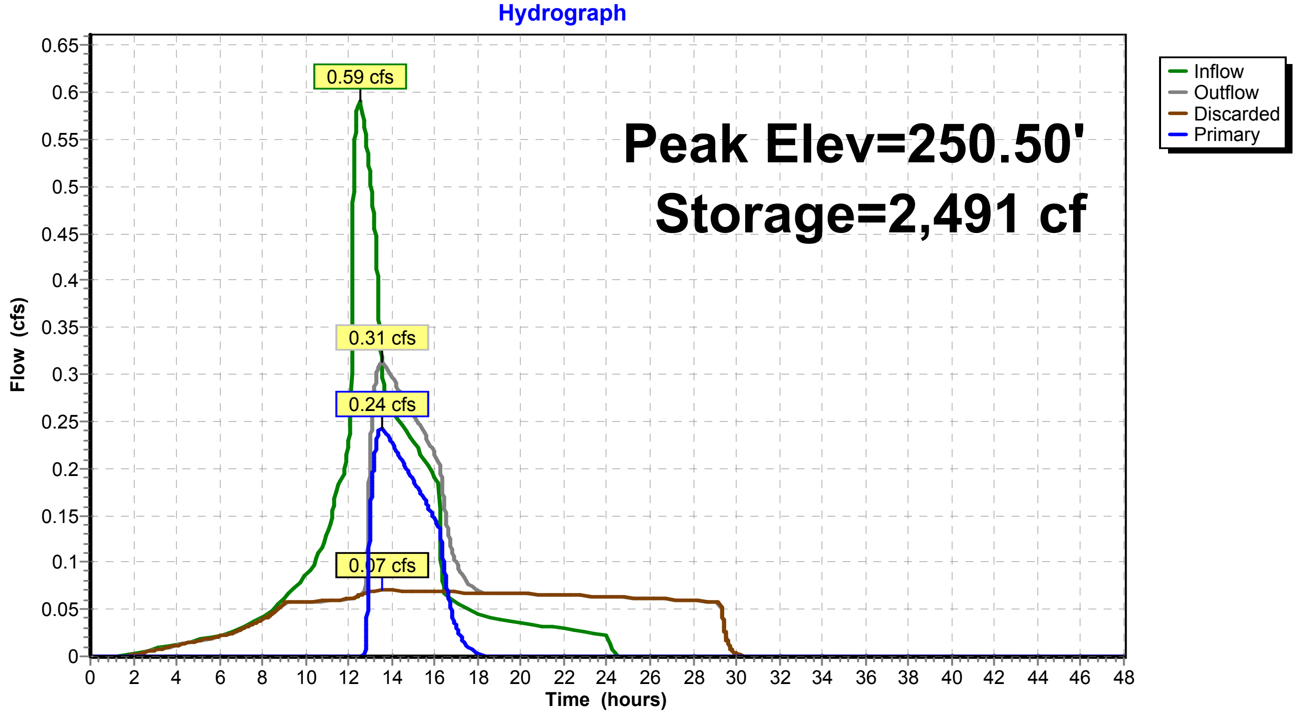
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.50'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	250.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.07 cfs @ 13.54 hrs HW=250.50' (Free Discharge)
└─**4=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.24 cfs @ 13.54 hrs HW=250.50' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
├─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.00 cfs @ 0.09 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.24 cfs @ 2.78 fps)

Pond 4P: Stone Storage



Summary for Pond 5P: Galley

Inflow Area = 2.640 ac, 82.41% Impervious, Inflow Depth = 2.44" for 2-year event
Inflow = 7.46 cfs @ 12.07 hrs, Volume= 0.537 af
Outflow = 7.41 cfs @ 12.08 hrs, Volume= 0.521 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.02 cfs @ 12.08 hrs, Volume= 0.073 af
Primary = 7.39 cfs @ 12.08 hrs, Volume= 0.448 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 228.62' @ 12.08 hrs Surf.Area= 1,300 sf Storage= 3,778 cf

Plug-Flow detention time= 155.8 min calculated for 0.521 af (97% of inflow)
Center-of-Mass det. time= 137.8 min (922.8 - 785.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	224.30'	2,661 cf	**Galley 4x4x4** x 60 Inside #2
			Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
			Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#2A	223.30'	1,623 cf	**26.00'W x 50.00'L x 6.50'H Field A**
			8,450 cf Overall - 3,533 cf Embedded = 4,917 cf x 33.0% Voids
		4,283 cf	Total Available Storage

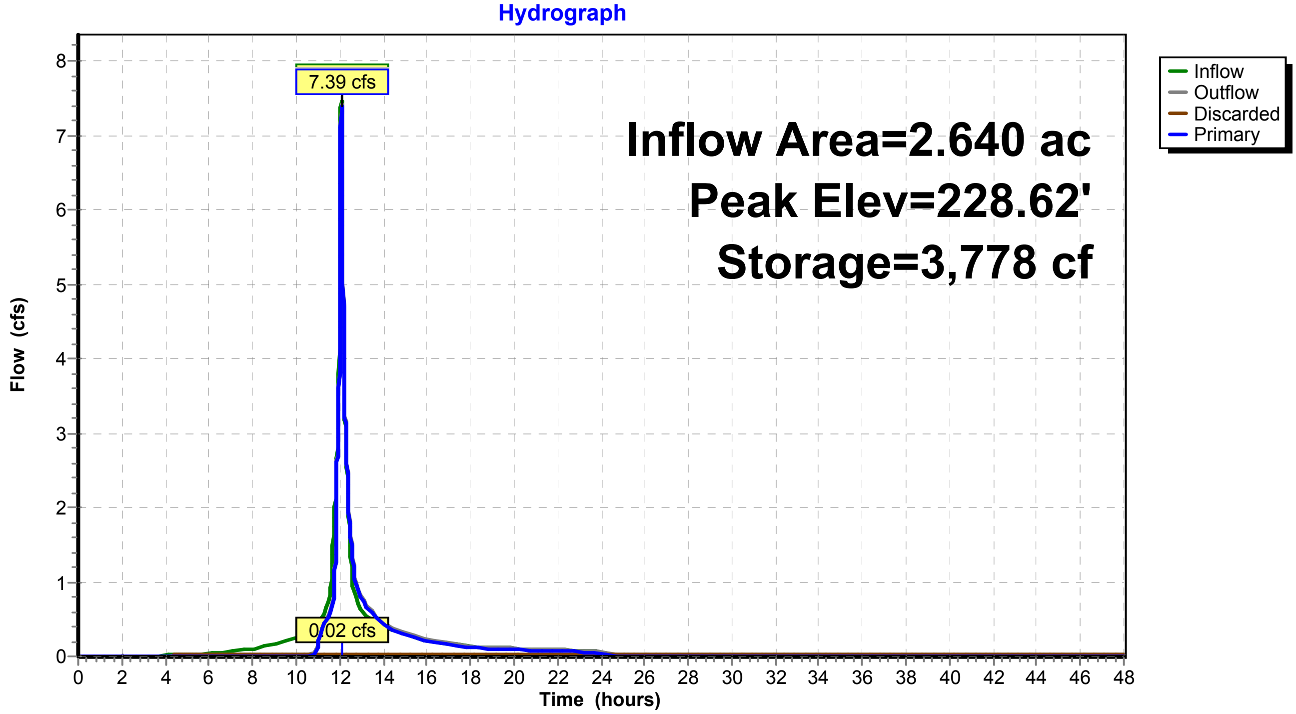
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	228.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	227.30'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir**
			Cv= 2.50 (C= 3.13)
#3	Primary	226.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	223.30'	**0.660 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.02 cfs @ 12.08 hrs HW=228.62' (Free Discharge)
└─**4=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=7.38 cfs @ 12.08 hrs HW=228.62' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 2.36 cfs @ 1.86 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 3.74 cfs @ 3.74 fps)
└─**3=Orifice/Grate** (Orifice Controls 1.29 cfs @ 6.59 fps)

Pond 5P: Galley



Summary for Pond 6P: Stone Storage

[93] Warning: Storage range exceeded by 0.42'

Inflow	=	2.02 cfs @	12.21 hrs,	Volume=	0.387 af
Outflow	=	1.94 cfs @	12.21 hrs,	Volume=	0.361 af, Atten= 4%, Lag= 0.0 min
Discarded	=	0.05 cfs @	12.21 hrs,	Volume=	0.133 af
Primary	=	1.89 cfs @	12.21 hrs,	Volume=	0.229 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 251.63' @ 12.21 hrs Surf.Area= 2,521 sf Storage= 2,477 cf

Plug-Flow detention time= 226.7 min calculated for 0.361 af (93% of inflow)
Center-of-Mass det. time= 191.5 min (988.3 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	249.50'	389 cf	**ADS N-12 12** x 24 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	2,088 cf	**20.84'W x 121.00'L x 2.71'H Field A** 6,829 cf Overall - 502 cf Embedded = 6,327 cf x 33.0% Voids
		2,477 cf	Total Available Storage

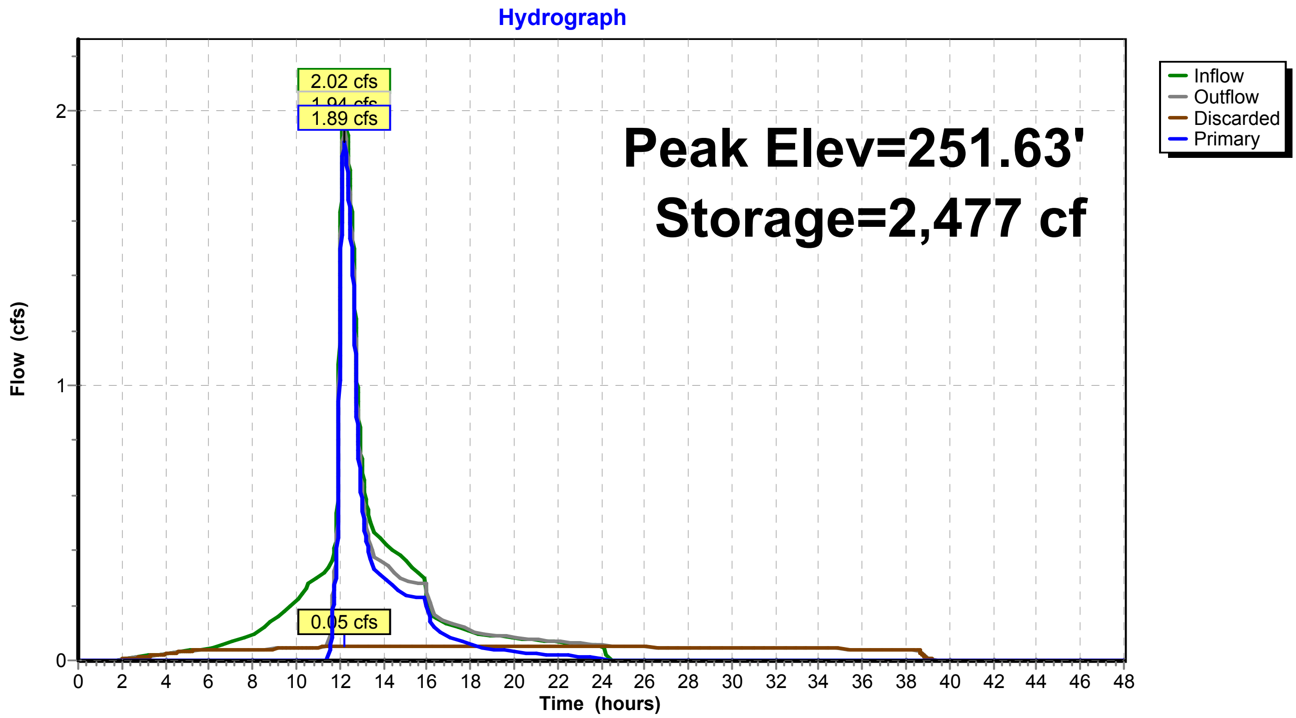
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 12.21 hrs HW=251.63' (Free Discharge)
└─**2=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=1.89 cfs @ 12.21 hrs HW=251.63' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 1.89 cfs @ 2.70 fps)

Pond 6P: Stone Storage



Summary for Pond 7P: Galley

[79] Warning: Submerged Pond 6P Primary device # 1 by 0.24'

Inflow Area =	3.200 ac,	89.99% Impervious,	Inflow Depth = 2.03"	for 2-year event
Inflow =	5.80 cfs @	12.10 hrs, Volume=	0.541 af	
Outflow =	5.53 cfs @	12.16 hrs, Volume=	0.504 af,	Atten= 5%, Lag= 3.5 min
Discarded =	0.03 cfs @	12.16 hrs, Volume=	0.119 af	
Primary =	5.50 cfs @	12.16 hrs, Volume=	0.384 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 251.24' @ 12.16 hrs Surf.Area= 0.050 ac Storage= 0.146 af

Plug-Flow detention time= 254.9 min calculated for 0.504 af (93% of inflow)
Center-of-Mass det. time= 223.0 min (1,014.1 - 791.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	247.00'	0.106 af	**Galley 4x4x4.25** x 100 Inside #2
			Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
			Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
#2A	246.00'	0.064 af	**26.50'W x 82.00'L x 6.75'H Field A**
			0.337 af Overall - 0.143 af Embedded = 0.194 af x 33.0% Voids
		0.170 af	Total Available Storage

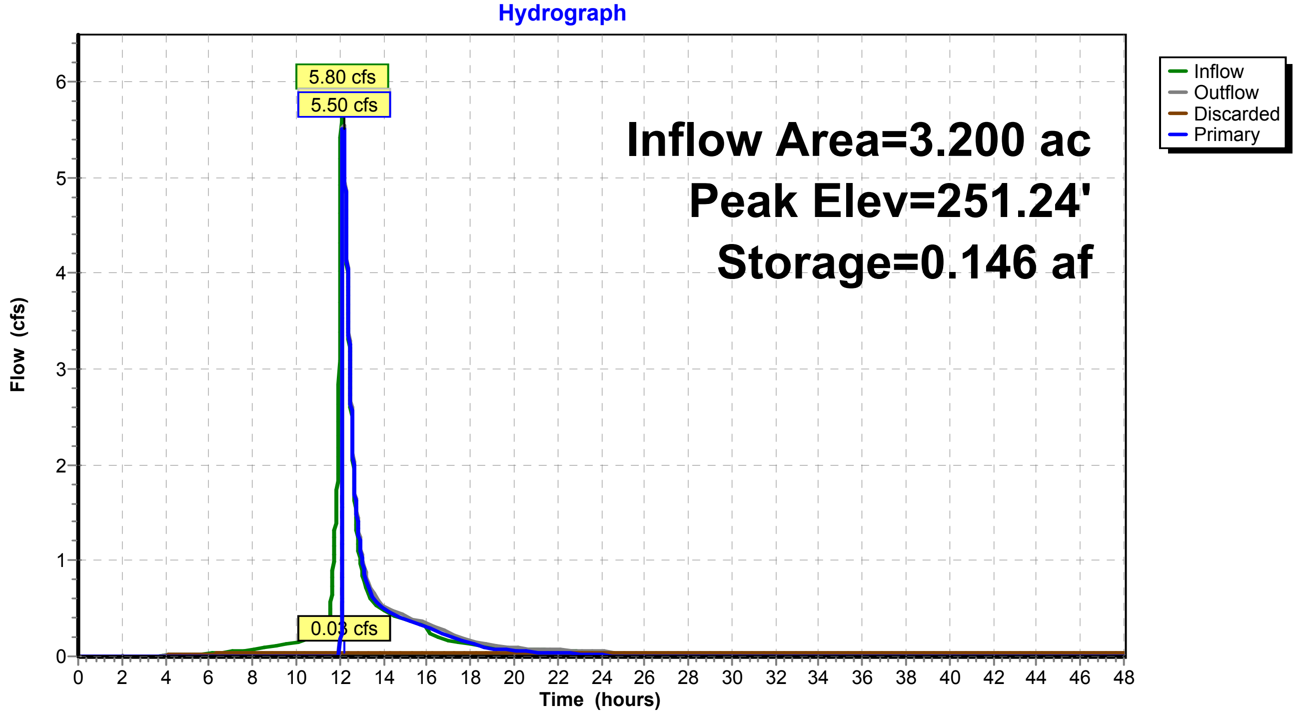
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.00'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir**
			Cv= 2.50 (C= 3.13)
#3	Primary	249.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	246.00'	**0.660 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=251.24' (Free Discharge)
└─**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=5.48 cfs @ 12.16 hrs HW=251.24' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 1.49 cfs @ 1.59 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 3.46 cfs @ 3.46 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.53 cfs @ 6.03 fps)

Pond 7P: Galley



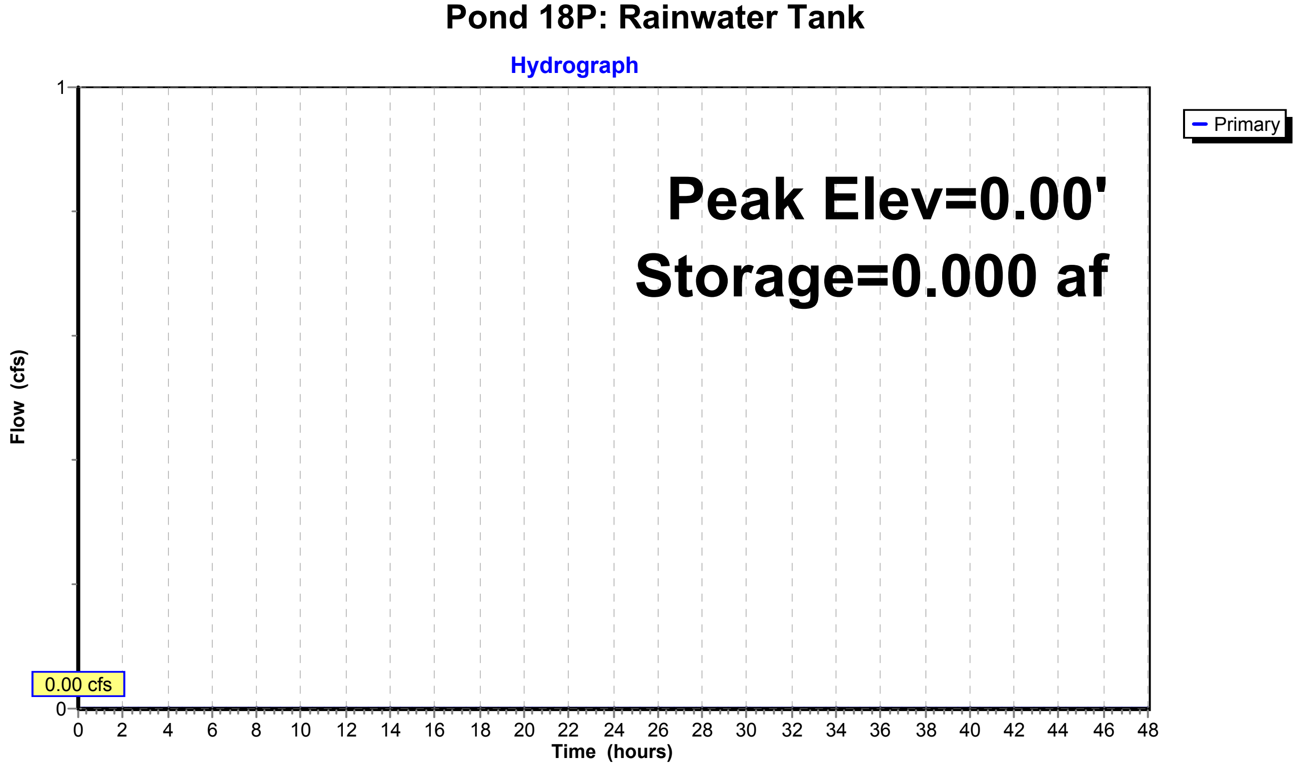
Summary for Pond 18P: Rainwater Tank

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	248.50'	0.038 af	**90.0" Round Pipe Storage** L= 37.5'

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Orifice/Grate** (Controls 0.00 cfs)

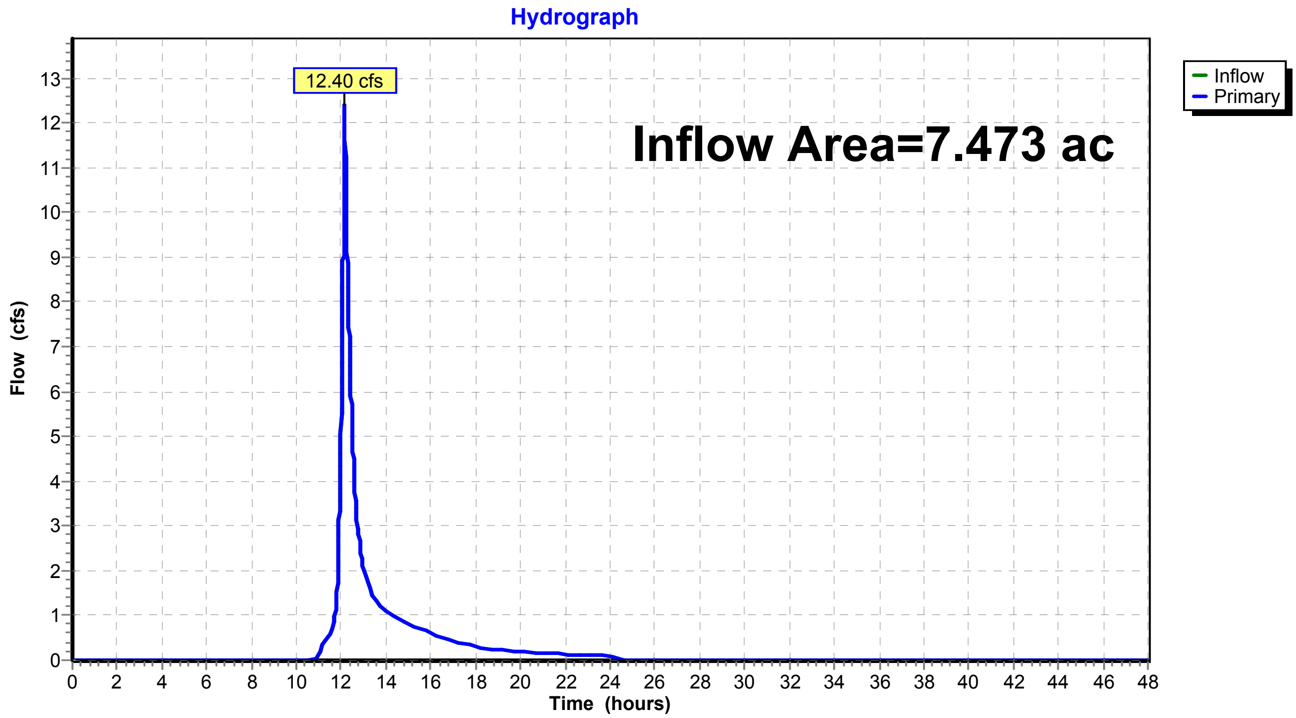


Summary for Link DP1: Reservoir

Inflow Area = 7.473 ac, 67.65% Impervious, Inflow Depth = 1.55" for 2-year event
Inflow = 12.40 cfs @ 12.15 hrs, Volume= 0.964 af
Primary = 12.40 cfs @ 12.15 hrs, Volume= 0.964 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

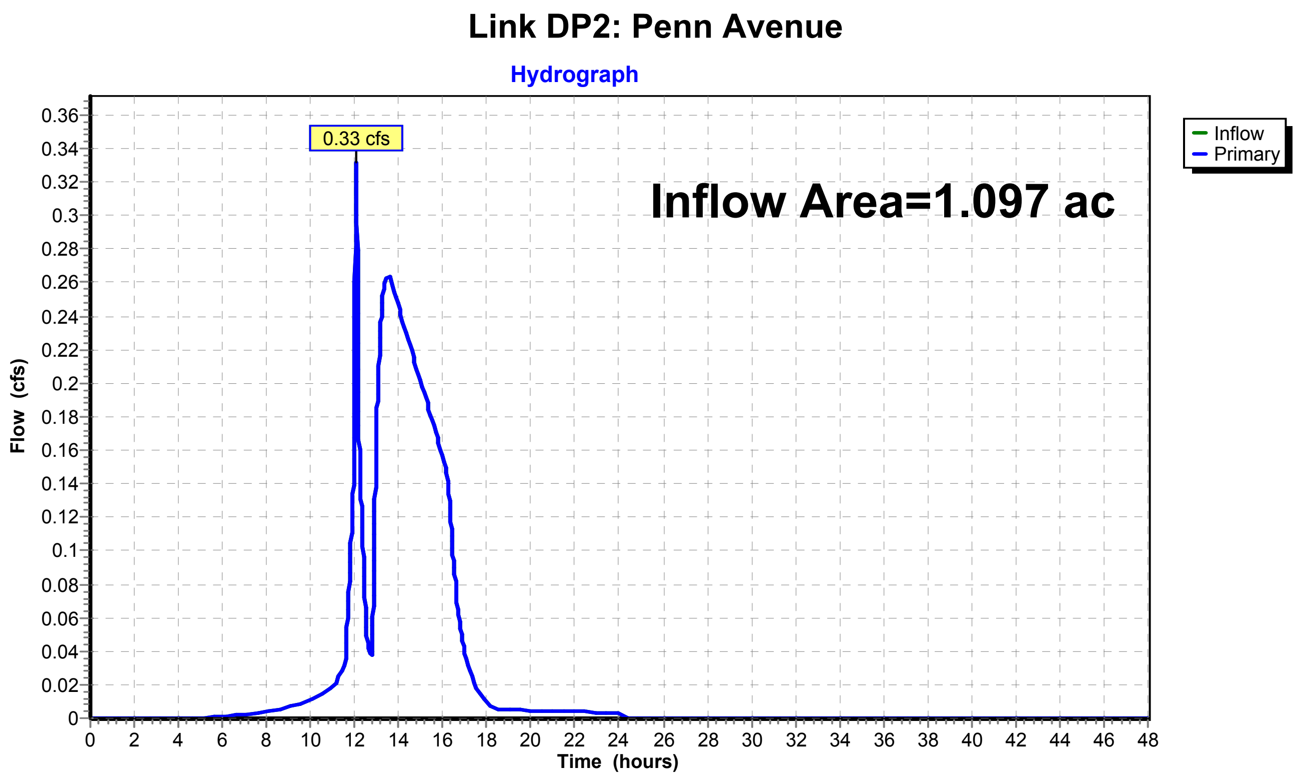
Link DP1: Reservoir



Summary for Link DP2: Penn Avenue

Inflow Area = 1.097 ac, 66.97% Impervious, Inflow Depth = 0.90" for 2-year event
Inflow = 0.33 cfs @ 12.07 hrs, Volume= 0.083 af
Primary = 0.33 cfs @ 12.07 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

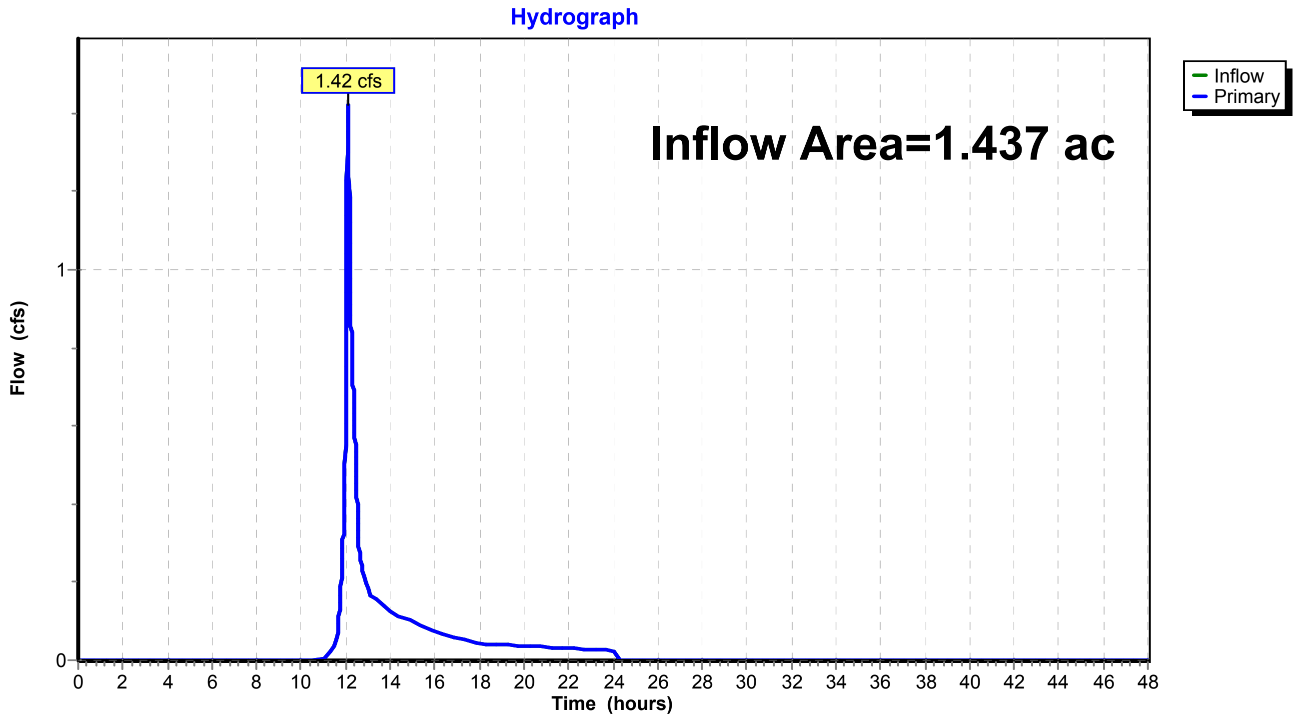


Summary for Link DP3: Swale (Existing)

Inflow Area = 1.437 ac, 0.00% Impervious, Inflow Depth = 0.92" for 2-year event
Inflow = 1.42 cfs @ 12.10 hrs, Volume= 0.110 af
Primary = 1.42 cfs @ 12.10 hrs, Volume= 0.110 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP3: Swale (Existing)

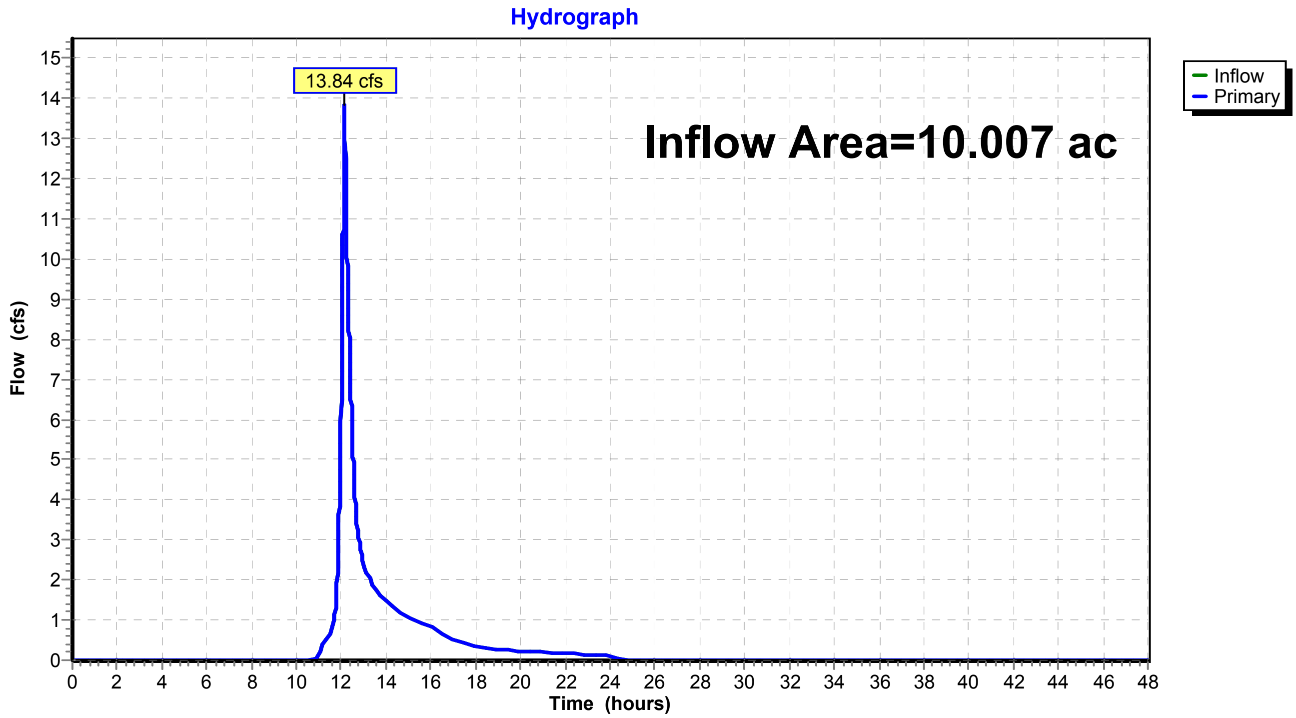


Summary for Link Site: Total Site

Inflow Area = 10.007 ac, 57.86% Impervious, Inflow Depth = 1.39" for 2-year event
Inflow = 13.84 cfs @ 12.15 hrs, Volume= 1.157 af
Primary = 13.84 cfs @ 12.15 hrs, Volume= 1.157 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Site: Total Site

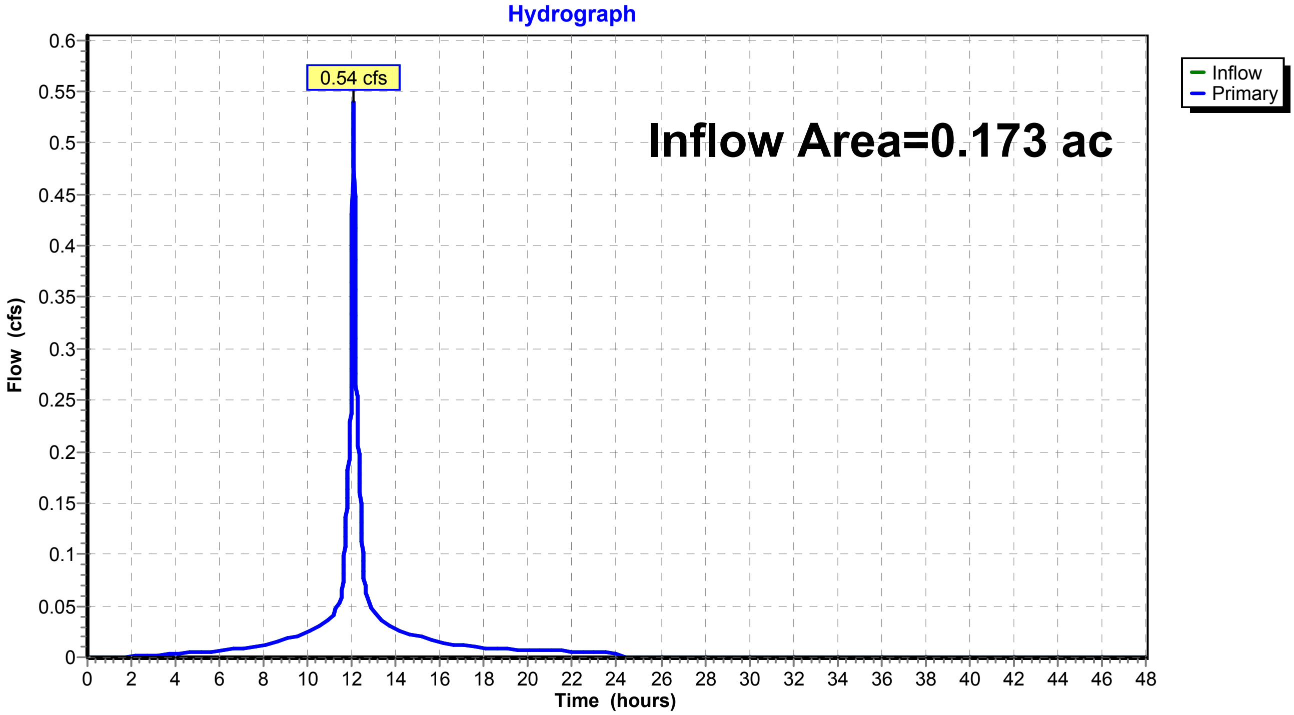


Summary for Link wqu: 450 i

Inflow Area =	0.173 ac,100.00% Impervious,	Inflow Depth = 2.87"	for 2-year event	
Inflow =	0.54 cfs @	12.07 hrs, Volume=	0.041 af	
Primary =	0.54 cfs @	12.07 hrs, Volume=	0.041 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link wqu: 450 i



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Building Runoff Area=55,869 sf 100.00% Impervious Runoff Depth=4.36"
Tc=10.0 min CN=98 Runoff=5.06 cfs 0.466 af

Subcatchment2: Back Lot/LA Runoff Area=31,419 sf 67.58% Impervious Runoff Depth=3.49"
Tc=5.0 min CN=90 Runoff=2.97 cfs 0.210 af

Subcatchment3: Paved Lot/LA Runoff Area=44,557 sf 91.54% Impervious Runoff Depth=4.14"
Tc=5.0 min CN=96 Runoff=4.68 cfs 0.352 af

Subcatchment4: Paved Lot/LA Runoff Area=49,545 sf 68.78% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=91 Runoff=4.78 cfs 0.341 af

Subcatchment5: Paved Lot/LA Runoff Area=65,440 sf 92.74% Impervious Runoff Depth=4.14"
Tc=5.0 min CN=96 Runoff=6.87 cfs 0.518 af

Subcatchment6: LA South Runoff Area=71,141 sf 0.00% Impervious Runoff Depth=2.05"
Flow Length=550' Tc=9.6 min CN=74 Runoff=3.43 cfs 0.279 af

Subcatchment7: Building Runoff Area=27,935 sf 100.00% Impervious Runoff Depth=4.36"
Tc=10.0 min CN=98 Runoff=2.53 cfs 0.233 af

Subcatchment8: LA Area Runoff Area=14,620 sf 0.00% Impervious Runoff Depth=2.05"
Flow Length=50' Slope=0.0100 '/' Tc=7.4 min CN=74 Runoff=0.76 cfs 0.057 af

Subcatchment9: Paved Lot Runoff Area=5,216 sf 77.76% Impervious Runoff Depth=3.81"
Tc=5.0 min CN=93 Runoff=0.52 cfs 0.038 af

Subcatchment10: Wooded Area Runoff Area=62,614 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=470' Tc=6.4 min CN=73 Runoff=3.23 cfs 0.236 af

Subcatchment11: Paved Lot Runoff Area=7,547 sf 100.00% Impervious Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.81 cfs 0.063 af

Pond 1P: Surface Detention Peak Elev=255.45' Storage=3,499 cf Inflow=3.27 cfs 0.291 af
Primary=0.42 cfs 0.015 af Secondary=0.78 cfs 0.276 af Outflow=1.21 cfs 0.291 af

Pond 2P: Surface Detention Peak Elev=254.74' Storage=3,936 cf Inflow=7.59 cfs 0.676 af
Primary=3.92 cfs 0.125 af Secondary=2.36 cfs 0.551 af Outflow=6.29 cfs 0.676 af

Pond 4P: Stone Storage Peak Elev=250.86' Storage=3,000 cf Inflow=0.78 cfs 0.276 af
Discarded=0.07 cfs 0.141 af Primary=0.55 cfs 0.135 af Outflow=0.62 cfs 0.276 af

Pond 5P: Galley Peak Elev=228.89' Storage=3,892 cf Inflow=11.65 cfs 0.858 af
Discarded=0.02 cfs 0.075 af Primary=11.57 cfs 0.767 af Outflow=11.59 cfs 0.842 af

Pond 6P: Stone Storage Peak Elev=251.70' Storage=2,477 cf Inflow=2.36 cfs 0.551 af
Discarded=0.05 cfs 0.140 af Primary=2.31 cfs 0.411 af Outflow=2.36 cfs 0.551 af

Pond 7P: Galley Peak Elev=251.55' Storage=0.151 af Inflow=10.24 cfs 0.952 af
Discarded=0.03 cfs 0.124 af Primary=10.15 cfs 0.789 af Outflow=10.19 cfs 0.913 af

Pond 18P: Rainwater Tank Peak Elev=0.00' Storage=0.000 af
Primary=0.00 cfs 0.000 af

Link DP1: Reservoir Inflow=24.35 cfs 1.835 af
Primary=24.35 cfs 1.835 af

Link DP2: Penn Avenue Inflow=0.70 cfs 0.188 af
Primary=0.70 cfs 0.188 af

Link DP3: Swale (Existing) Inflow=3.23 cfs 0.236 af
Primary=3.23 cfs 0.236 af

Link Site: Total Site Inflow=28.08 cfs 2.259 af
Primary=28.08 cfs 2.259 af

Link wqu: 450 i Inflow=0.81 cfs 0.063 af
Primary=0.81 cfs 0.063 af

Total Runoff Area = 10.007 ac Runoff Volume = 2.794 af Average Runoff Depth = 3.35"
42.14% Pervious = 4.217 ac 57.86% Impervious = 5.790 ac

Summary for Subcatchment 1: Building

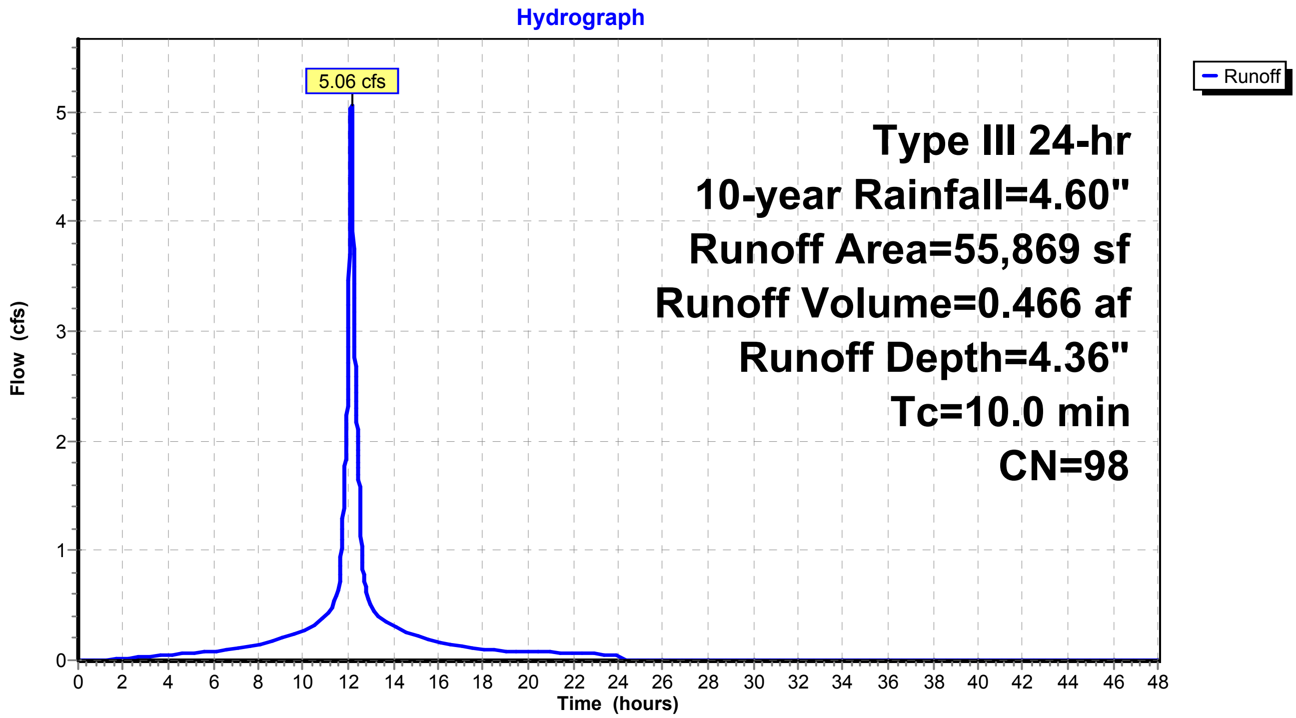
Runoff = 5.06 cfs @ 12.13 hrs, Volume= 0.466 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
55,869	98	Roofs, HSG C
55,869		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1: Building



Summary for Subcatchment 2: Back Lot/LA

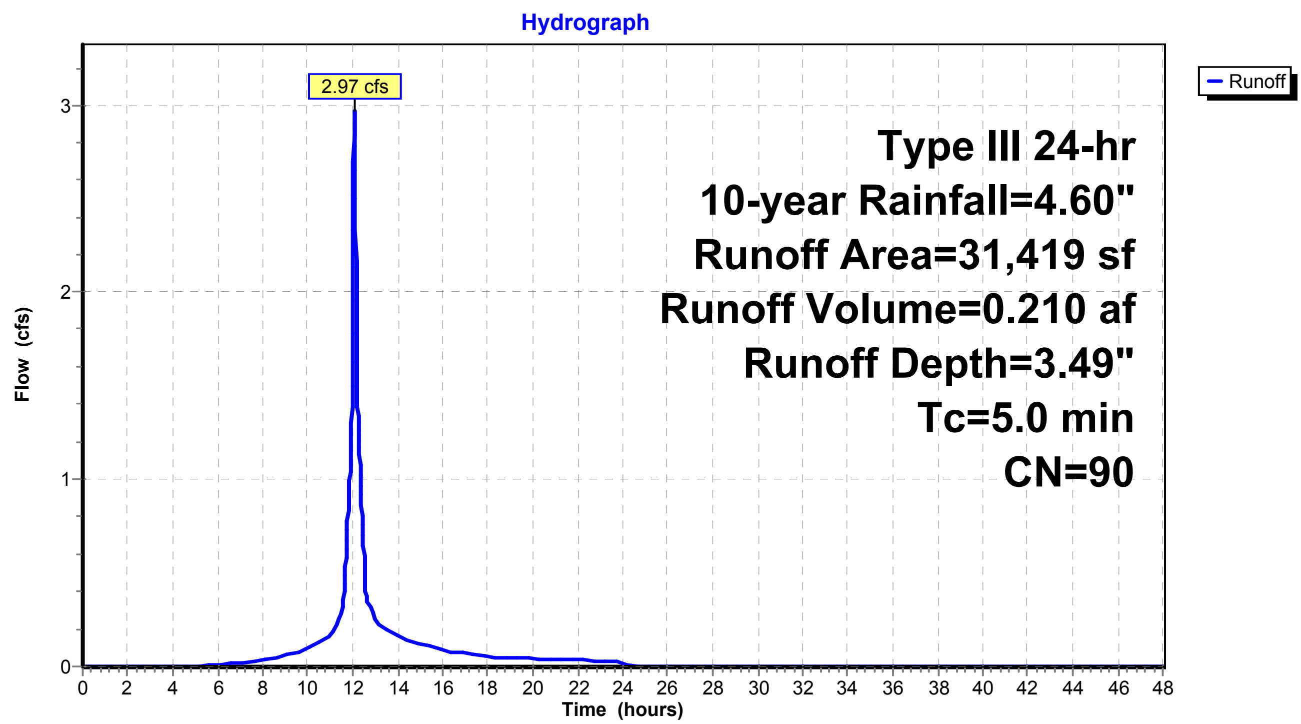
Runoff = 2.97 cfs @ 12.07 hrs, Volume= 0.210 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
21,234	98	Paved parking, HSG C
10,185	74	>75% Grass cover, Good, HSG C
31,419	90	Weighted Average
10,185		32.42% Pervious Area
21,234		67.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Back Lot/LA



Summary for Subcatchment 3: Paved Lot/LA

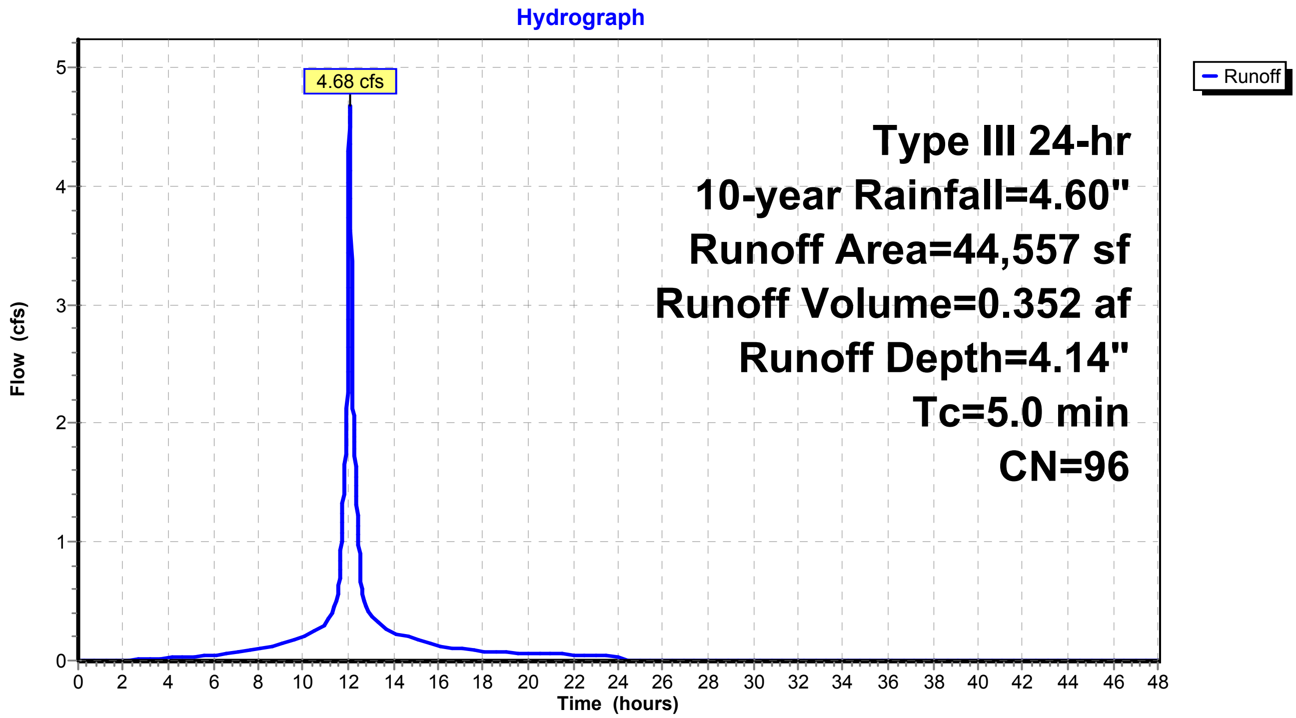
Runoff = 4.68 cfs @ 12.07 hrs, Volume= 0.352 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
40,788	98	Paved parking, HSG C
3,769	74	>75% Grass cover, Good, HSG C
44,557	96	Weighted Average
3,769		8.46% Pervious Area
40,788		91.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Paved Lot/LA



Summary for Subcatchment 4: Paved Lot/LA

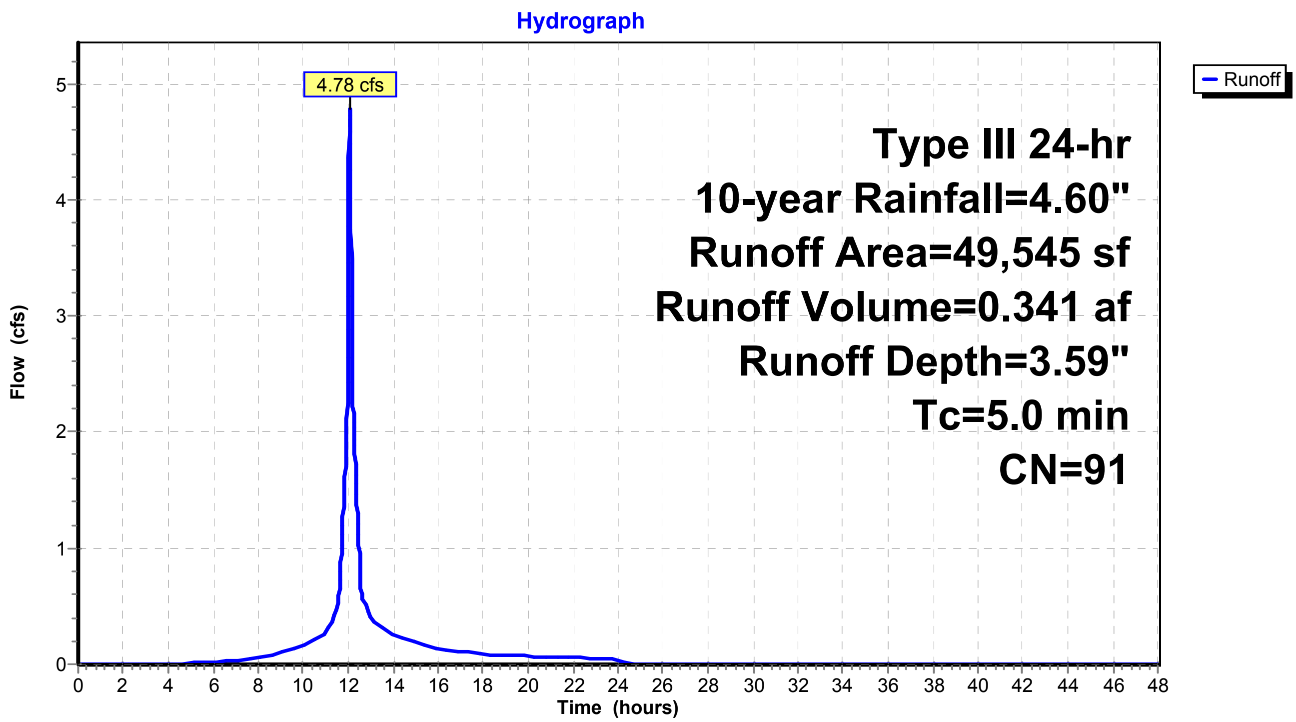
Runoff = 4.78 cfs @ 12.07 hrs, Volume= 0.341 af, Depth= 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

	Area (sf)	CN	Description
	34,076	98	Paved parking, HSG C
*	3,279	74	>75% Grass cover, Good, HSG C/Int LA
*	12,190	74	>75% Grass cover, Good, HSG C/LA north
	49,545	91	Weighted Average
	15,469		31.22% Pervious Area
	34,076		68.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Paved Lot/LA



Summary for Subcatchment 5: Paved Lot/LA

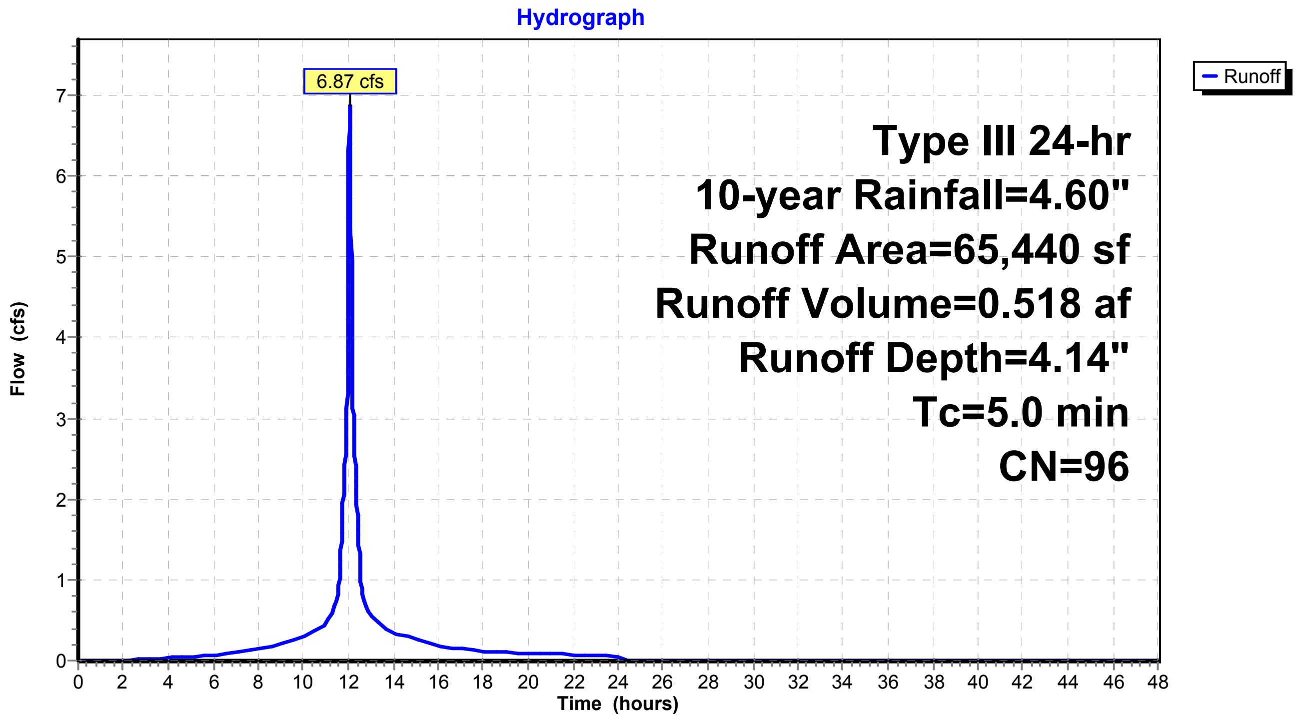
Runoff = 6.87 cfs @ 12.07 hrs, Volume= 0.518 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
60,688	98	Paved parking, HSG C
4,752	74	>75% Grass cover, Good, HSG C
65,440	96	Weighted Average
4,752		7.26% Pervious Area
60,688		92.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Paved Lot/LA



Summary for Subcatchment 6: LA South

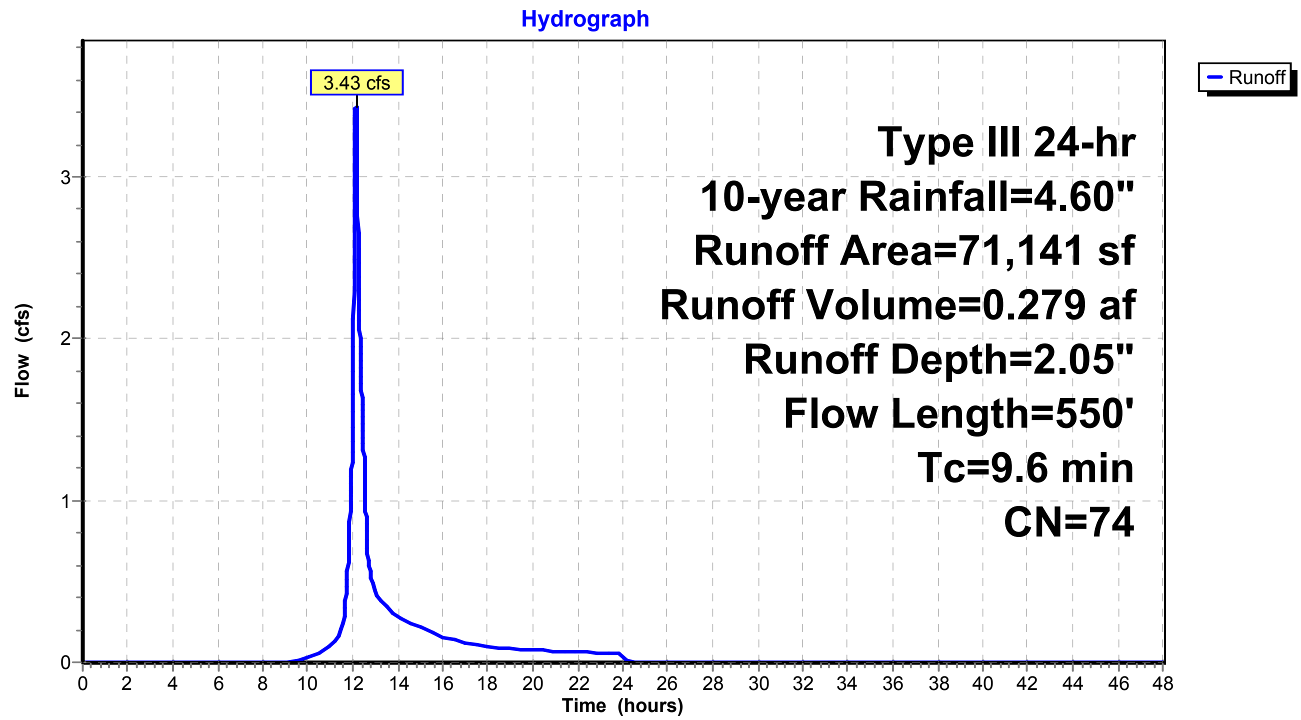
Runoff = 3.43 cfs @ 12.14 hrs, Volume= 0.279 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
71,141	74	>75% Grass cover, Good, HSG C
71,141		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	50	0.1000	0.28		**Sheet Flow, Grass/Wooded Area** Grass: Short n= 0.150 P2= 3.20"
6.0	400	0.0500	1.12		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
0.6	100	0.3000	2.74		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
9.6	550	Total			

Subcatchment 6: LA South



Summary for Subcatchment 7: Building

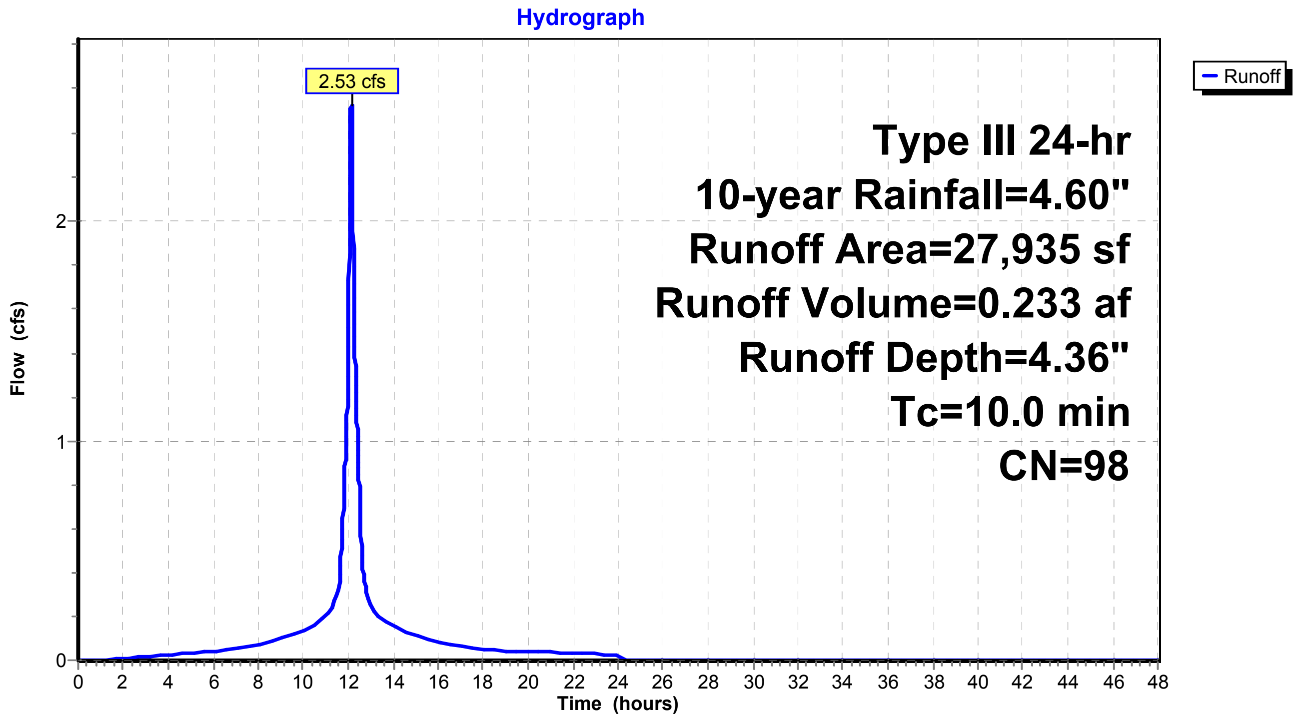
Runoff = 2.53 cfs @ 12.13 hrs, Volume= 0.233 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
27,935	98	Roofs, HSG C
27,935		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 7: Building



Summary for Subcatchment 8: LA Area

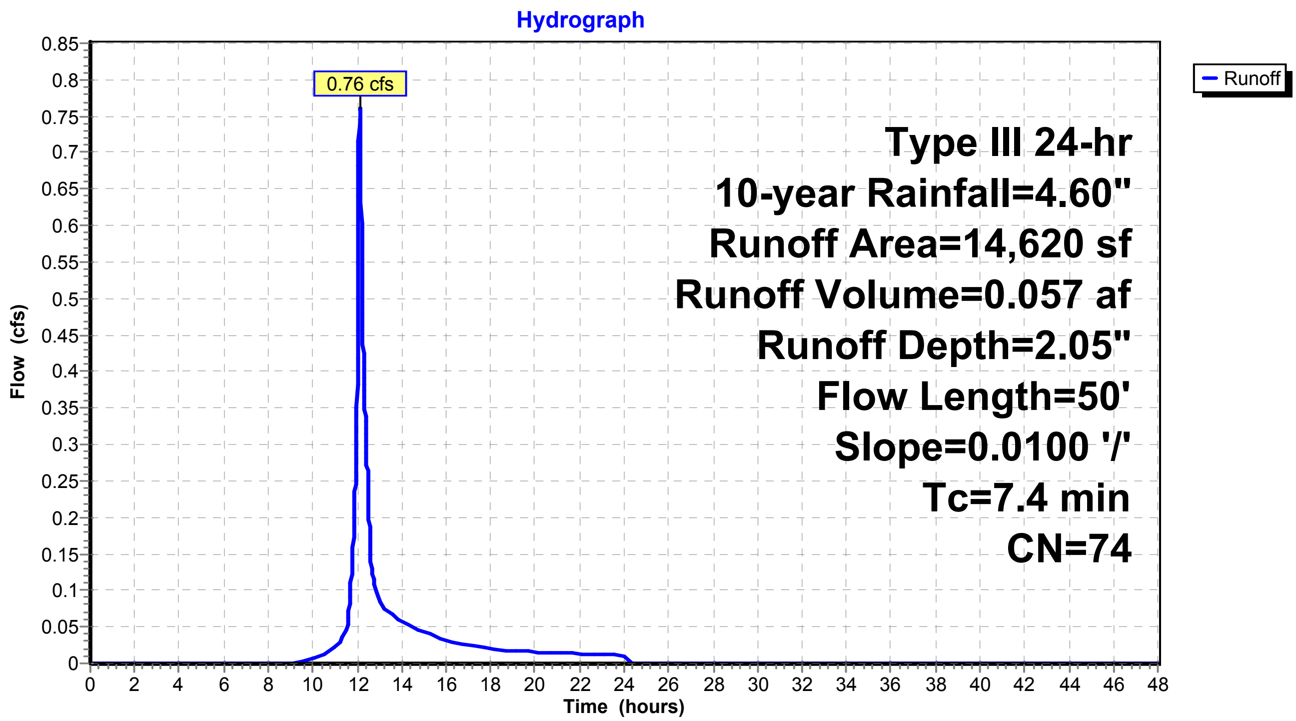
Runoff = 0.76 cfs @ 12.11 hrs, Volume= 0.057 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
14,620	74	>75% Grass cover, Good, HSG C
14,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, Grass Area** Grass: Short n= 0.150 P2= 3.20"

Subcatchment 8: LA Area



Summary for Subcatchment 9: Paved Lot

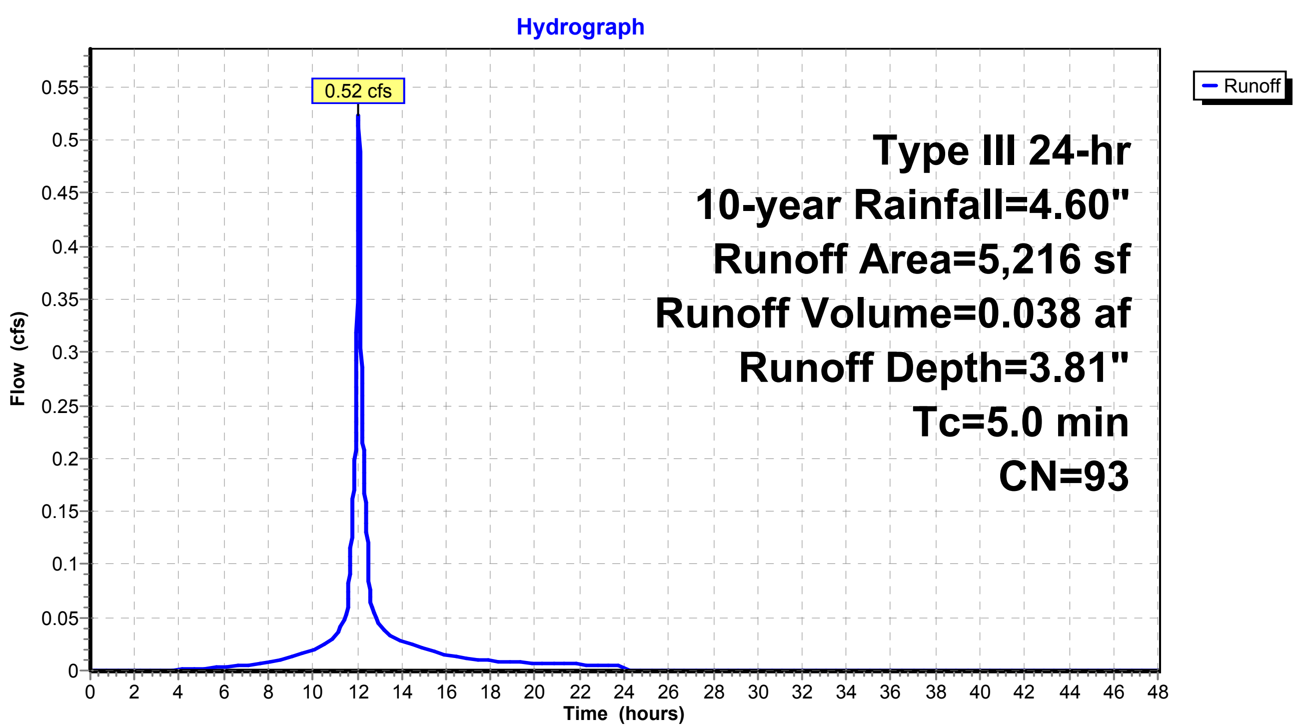
Runoff = 0.52 cfs @ 12.07 hrs, Volume= 0.038 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

	Area (sf)	CN	Description
*	4,056	98	Paved Driveway, HSG C
	1,160	74	>75% Grass cover, Good, HSG C
	5,216	93	Weighted Average
	1,160		22.24% Pervious Area
	4,056		77.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9: Paved Lot



Summary for Subcatchment 10: Wooded Area

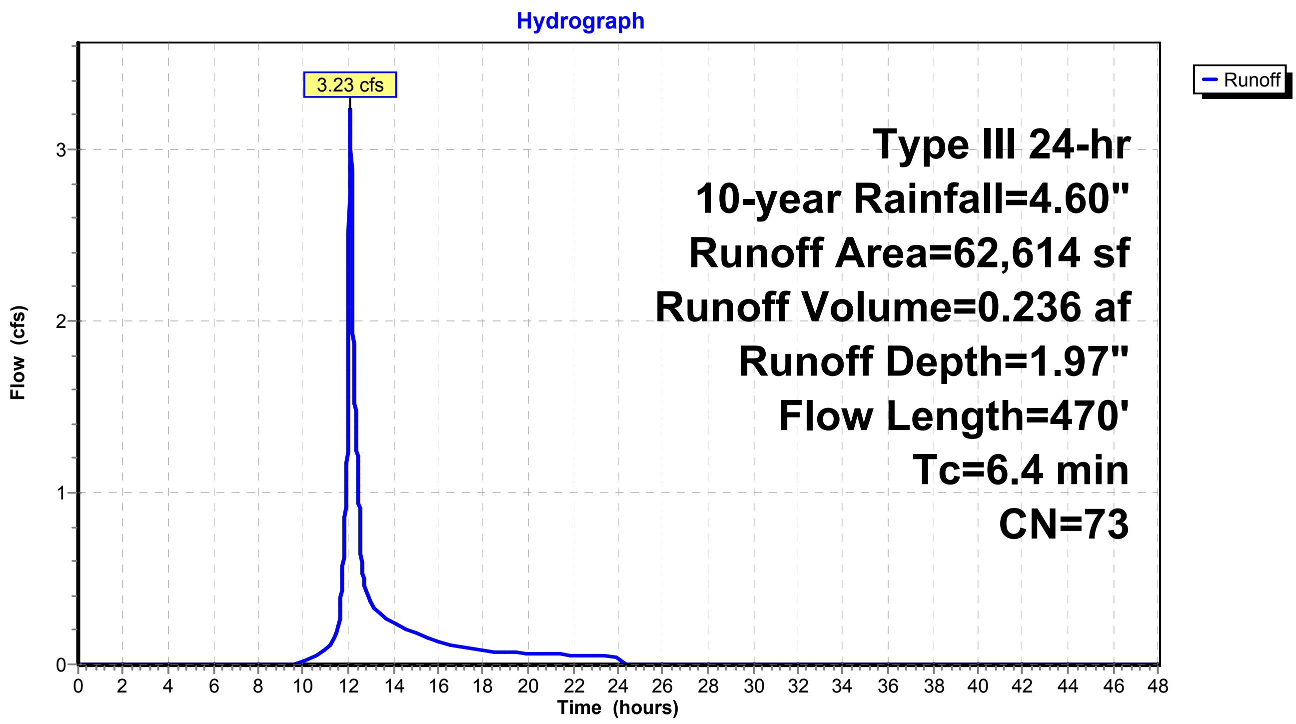
Runoff = 3.23 cfs @ 12.10 hrs, Volume= 0.236 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
62,614	73	Woods, Fair, HSG C
62,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.3000	0.20		**Sheet Flow, Wooded Area** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
6.4	470	Total			

Subcatchment 10: Wooded Area



Summary for Subcatchment 11: Paved Lot

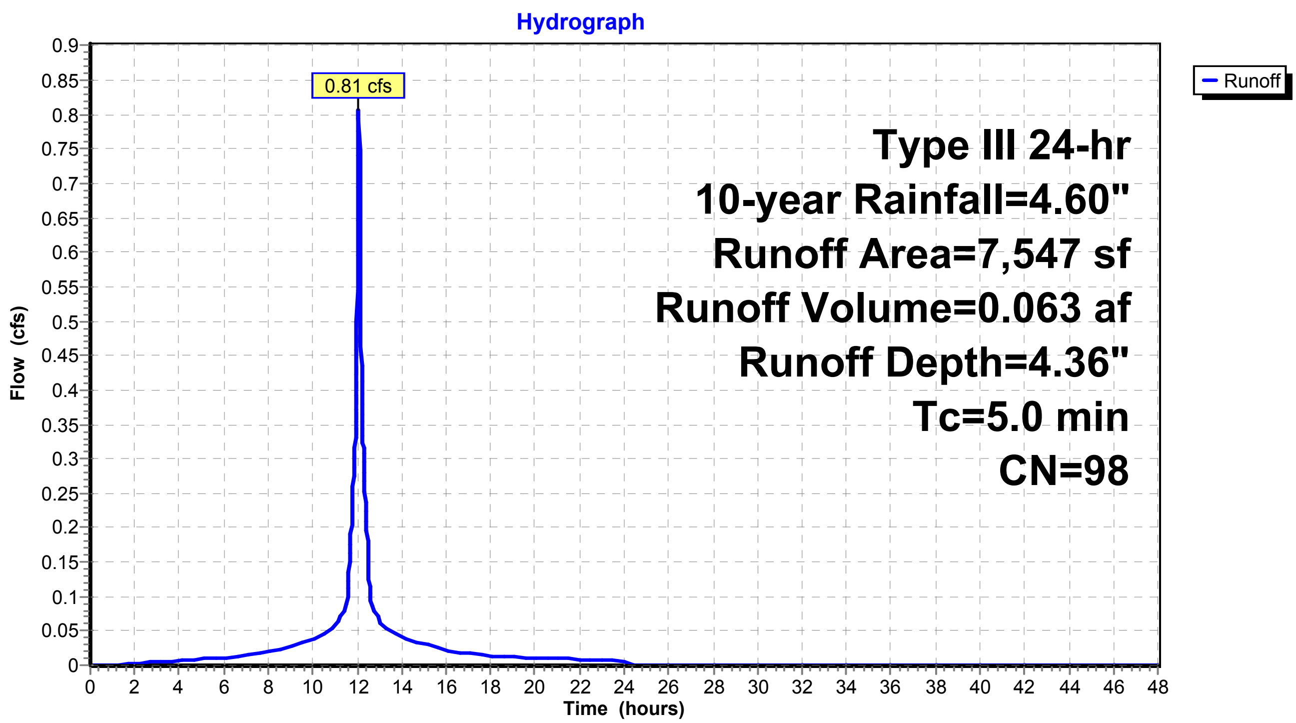
Runoff = 0.81 cfs @ 12.07 hrs, Volume= 0.063 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
7,547	98	Paved parking, HSG C
7,547		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11: Paved Lot



Summary for Pond 1P: Surface Detention

Inflow Area = 0.977 ac, 65.64% Impervious, Inflow Depth = 3.57" for 10-year event
Inflow = 3.27 cfs @ 12.13 hrs, Volume= 0.291 af
Outflow = 1.21 cfs @ 12.44 hrs, Volume= 0.291 af, Atten= 63%, Lag= 18.7 min
Primary = 0.42 cfs @ 12.44 hrs, Volume= 0.015 af
Secondary = 0.78 cfs @ 12.44 hrs, Volume= 0.276 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 255.45' @ 12.44 hrs Surf.Area= 3,310 sf Storage= 3,499 cf
Flood Elev= 257.00' Surf.Area= 5,368 sf Storage= 10,203 cf

Plug-Flow detention time= 39.6 min calculated for 0.290 af (100% of inflow)
Center-of-Mass det. time= 39.6 min (810.4 - 770.9)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	10,203 cf	**Surface Detention (Irregular)** Listed below (Recalc)

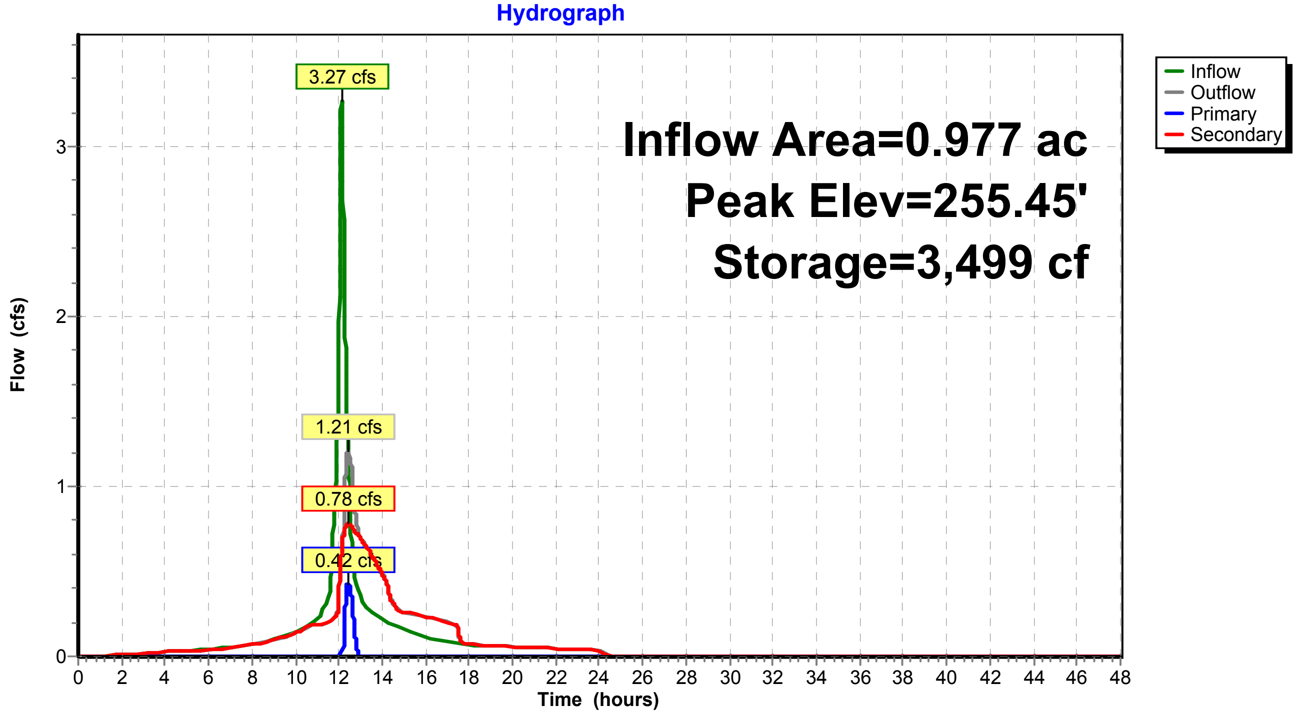
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
254.00	1,548	396.2	0	0	1,548
255.00	2,764	415.0	2,127	2,127	2,828
256.00	4,038	433.9	3,381	5,508	4,173
256.50	4,696	443.3	2,181	7,689	4,865
257.00	5,368	452.7	2,514	10,203	5,572

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	255.25'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	254.60'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	254.00'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=0.43 cfs @ 12.44 hrs HW=255.45' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Orifice/Grate (Orifice Controls 0.43 cfs @ 2.17 fps)

Secondary OutFlow Max=0.78 cfs @ 12.44 hrs HW=255.45' (Free Discharge)
3=Orifice/Grate (Orifice Controls 0.39 cfs @ 4.45 fps)
4=Exfiltration (Exfiltration Controls 0.40 cfs)

Pond 1P: Surface Detention



Summary for Pond 2P: Surface Detention

Inflow Area = 2.004 ac, 88.33% Impervious, Inflow Depth = 4.05" for 10-year event
Inflow = 7.59 cfs @ 12.10 hrs, Volume= 0.676 af
Outflow = 6.29 cfs @ 12.18 hrs, Volume= 0.676 af, Atten= 17%, Lag= 4.5 min
Primary = 3.92 cfs @ 12.18 hrs, Volume= 0.125 af
Secondary = 2.36 cfs @ 12.18 hrs, Volume= 0.551 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 254.74' @ 12.18 hrs Surf.Area= 3,872 sf Storage= 3,936 cf

Plug-Flow detention time= 17.0 min calculated for 0.676 af (100% of inflow)
Center-of-Mass det. time= 17.0 min (782.4 - 765.4)

Volume	Invert	Avail.Storage	Storage Description
#1	253.50'	9,744 cf	**Surface Detention (Irregular)**Listed below (Recalc)

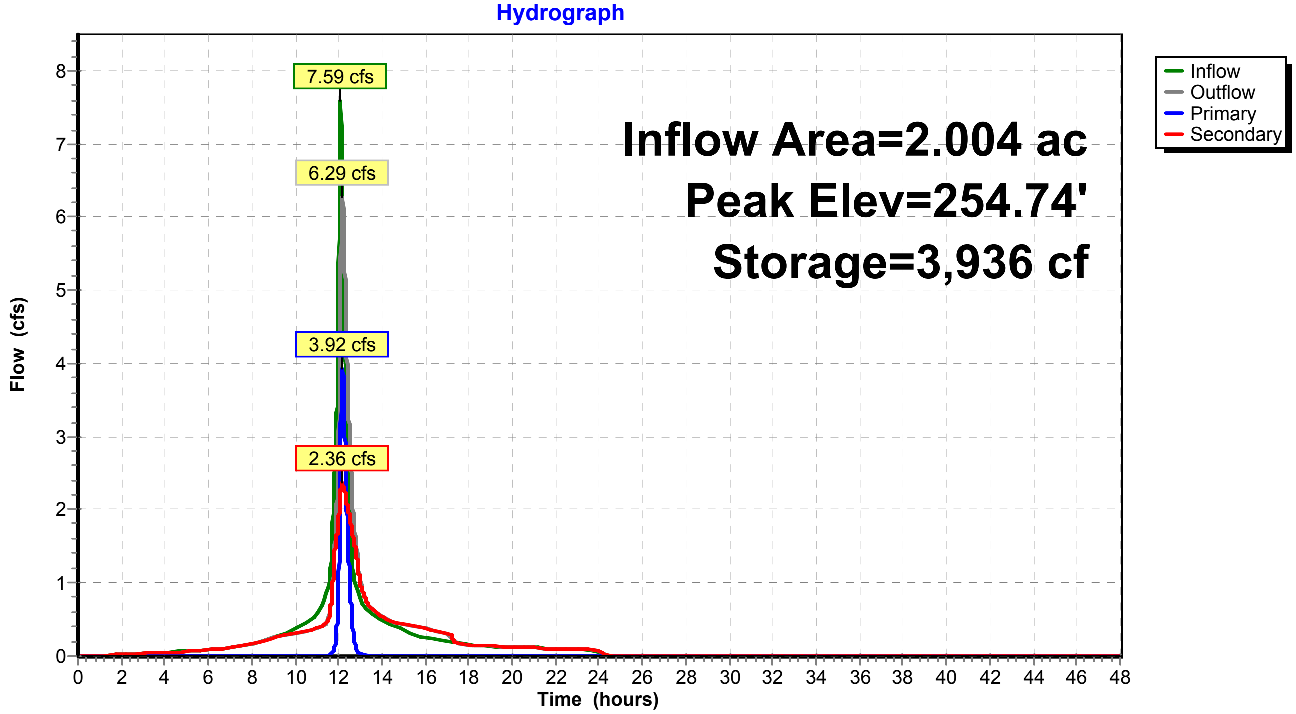
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.50	2,486	280.0	0	0	2,486
254.00	3,039	317.8	1,379	1,379	4,290
255.00	4,186	386.5	3,597	4,976	8,157
256.00	5,374	405.3	4,768	9,744	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	254.33'	**18.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	254.16'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	254.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	253.90'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	253.50'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=3.92 cfs @ 12.18 hrs HW=254.74' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Orifice/Grate (Orifice Controls 0.86 cfs @ 2.18 fps)
3=Orifice/Grate (Orifice Controls 1.23 cfs @ 2.60 fps)
4=Orifice/Grate (Orifice Controls 1.83 cfs @ 2.93 fps)

Secondary OutFlow Max=2.36 cfs @ 12.18 hrs HW=254.74' (Free Discharge)
5=Orifice/Grate (Orifice Controls 1.54 cfs @ 4.42 fps)
6=Exfiltration (Exfiltration Controls 0.82 cfs)

Pond 2P: Surface Detention



Summary for Pond 4P: Stone Storage

Inflow	=	0.78 cfs @	12.44 hrs,	Volume=	0.276 af
Outflow	=	0.62 cfs @	13.38 hrs,	Volume=	0.276 af, Atten= 21%, Lag= 56.5 min
Discarded	=	0.07 cfs @	13.38 hrs,	Volume=	0.141 af
Primary	=	0.55 cfs @	13.38 hrs,	Volume=	0.135 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 250.86' @ 13.38 hrs Surf.Area= 3,771 sf Storage= 3,000 cf

Plug-Flow detention time= 167.7 min calculated for 0.276 af (100% of inflow)
Center-of-Mass det. time= 167.7 min (981.4 - 813.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	250.50'	583 cf	**ADS N-12 12** x 36 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	4,367 cf	**20.84'W x 181.00'L x 3.71'H Field A** 13,987 cf Overall - 754 cf Embedded = 13,233 cf x 33.0% Voids
		4,950 cf	Total Available Storage

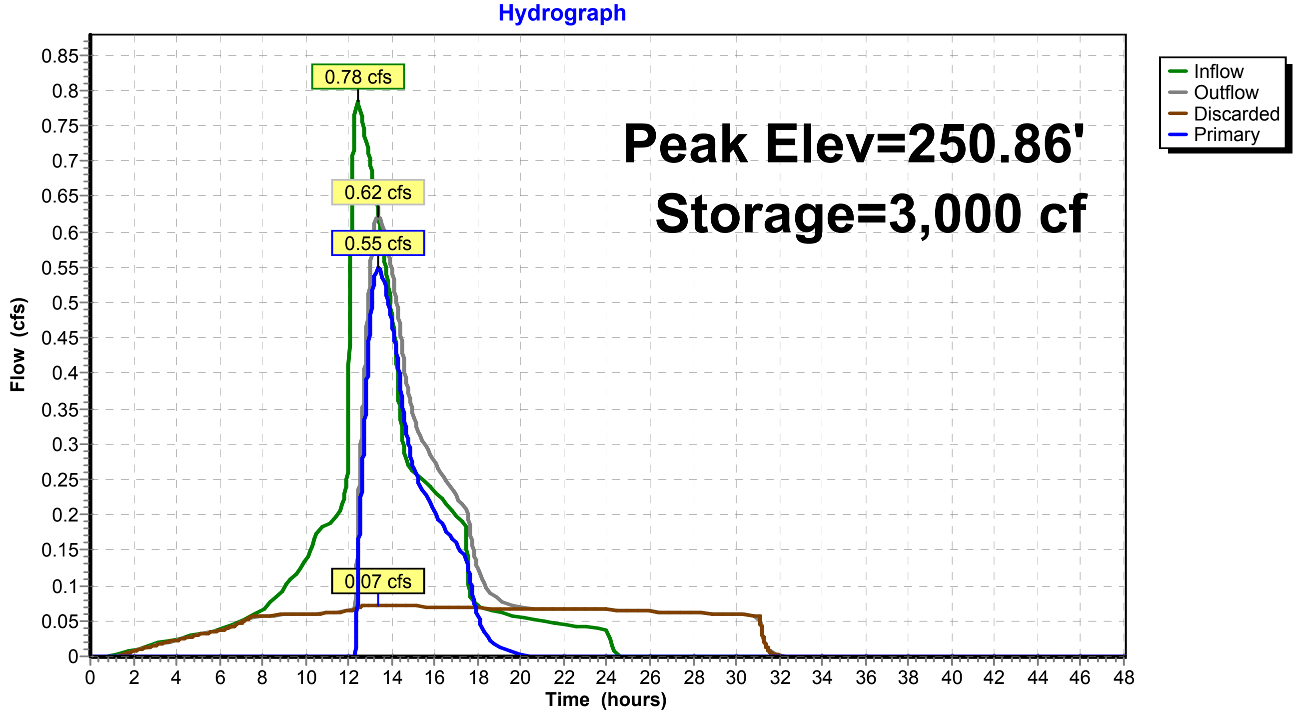
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.50'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	250.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.07 cfs @ 13.38 hrs HW=250.86' (Free Discharge)
└─**4=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.55 cfs @ 13.38 hrs HW=250.86' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
├─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.20 cfs @ 1.51 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.35 cfs @ 4.02 fps)

Pond 4P: Stone Storage



Summary for Pond 5P: Galley

Inflow Area = 2.640 ac, 82.41% Impervious, Inflow Depth = 3.90" for 10-year event
Inflow = 11.65 cfs @ 12.07 hrs, Volume= 0.858 af
Outflow = 11.59 cfs @ 12.08 hrs, Volume= 0.842 af, Atten= 0%, Lag= 0.4 min
Discarded = 0.02 cfs @ 12.08 hrs, Volume= 0.075 af
Primary = 11.57 cfs @ 12.08 hrs, Volume= 0.767 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 228.89' @ 12.08 hrs Surf.Area= 1,300 sf Storage= 3,892 cf

Plug-Flow detention time= 106.7 min calculated for 0.842 af (98% of inflow)
Center-of-Mass det. time= 94.5 min (868.0 - 773.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	224.30'	2,661 cf	**Galley 4x4x4** x 60 Inside #2 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#2A	223.30'	1,623 cf	**26.00'W x 50.00'L x 6.50'H Field A** 8,450 cf Overall - 3,533 cf Embedded = 4,917 cf x 33.0% Voids
		4,283 cf	Total Available Storage

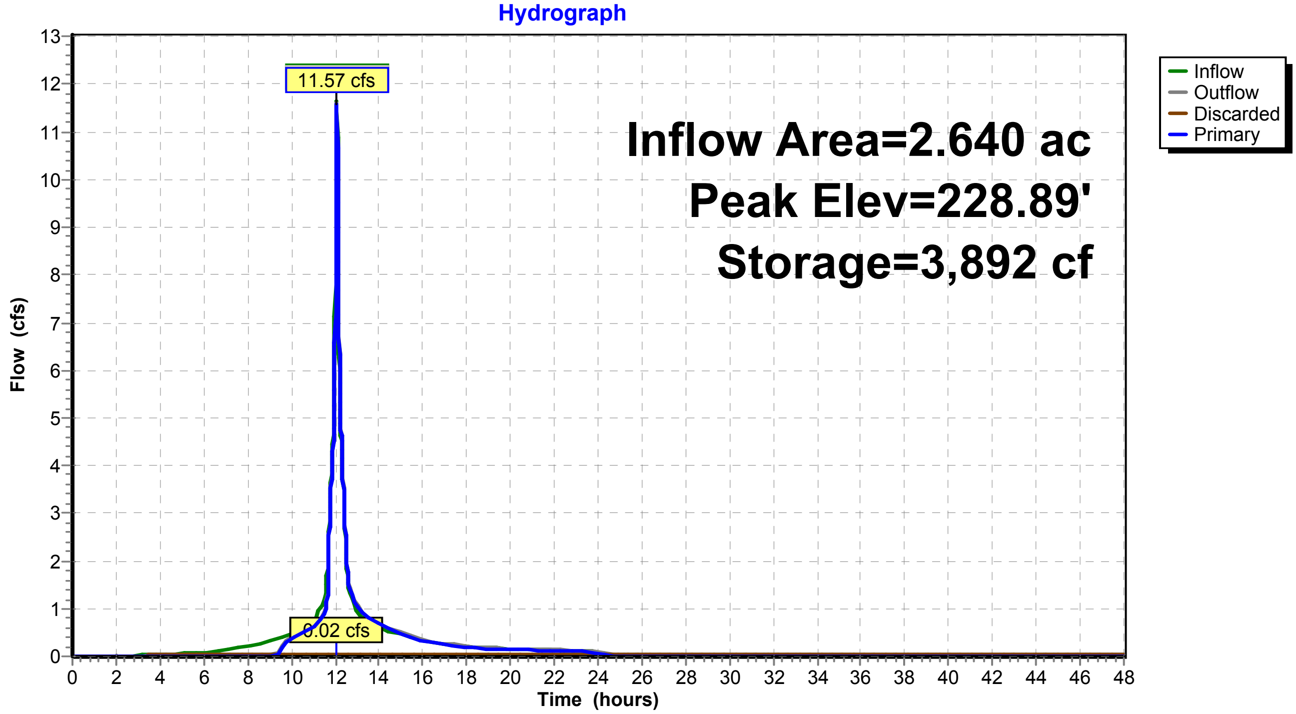
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	228.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	227.30'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	226.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	223.30'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.02 cfs @ 12.08 hrs HW=228.89' (Free Discharge)
└─**4=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=11.56 cfs @ 12.08 hrs HW=228.89' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 5.71 cfs @ 2.51 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 4.46 cfs @ 4.46 fps)
└─**3=Orifice/Grate** (Orifice Controls 1.38 cfs @ 7.04 fps)

Pond 5P: Galley



Summary for Pond 6P: Stone Storage

[93] Warning: Storage range exceeded by 0.49'

Inflow	=	2.36 cfs @	12.18 hrs,	Volume=	0.551 af
Outflow	=	2.36 cfs @	12.18 hrs,	Volume=	0.551 af, Atten= 0%, Lag= 0.0 min
Discarded	=	0.05 cfs @	12.18 hrs,	Volume=	0.140 af
Primary	=	2.31 cfs @	12.18 hrs,	Volume=	0.411 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 251.70' @ 12.18 hrs Surf.Area= 2,521 sf Storage= 2,477 cf

Plug-Flow detention time= 139.4 min calculated for 0.551 af (100% of inflow)
Center-of-Mass det. time= 138.6 min (931.5 - 793.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	249.50'	389 cf	**ADS N-12 12** x 24 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	2,088 cf	**20.84'W x 121.00'L x 2.71'H Field A** 6,829 cf Overall - 502 cf Embedded = 6,327 cf x 33.0% Voids
		2,477 cf	Total Available Storage

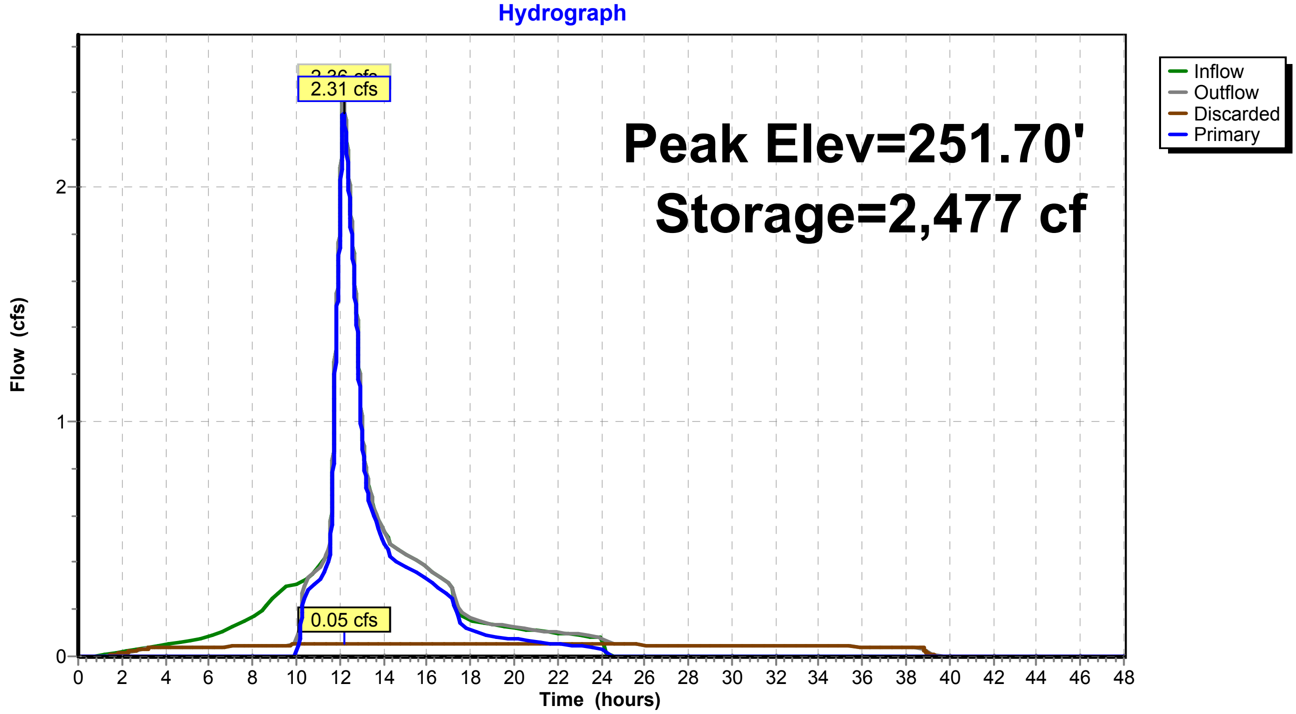
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 12.18 hrs HW=251.70' (Free Discharge)
└─**2=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.31 cfs @ 12.18 hrs HW=251.70' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 2.31 cfs @ 2.85 fps)

Pond 6P: Stone Storage



Summary for Pond 7P: Galley

[79] Warning: Submerged Pond 6P Primary device # 1 by 0.55'

Inflow Area = 3.200 ac, 89.99% Impervious, Inflow Depth = 3.57" for 10-year event
Inflow = 10.24 cfs @ 12.11 hrs, Volume= 0.952 af
Outflow = 10.19 cfs @ 12.12 hrs, Volume= 0.913 af, Atten= 1%, Lag= 0.8 min
Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.124 af
Primary = 10.15 cfs @ 12.12 hrs, Volume= 0.789 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 251.55' @ 12.12 hrs Surf.Area= 0.050 ac Storage= 0.151 af

Plug-Flow detention time= 156.8 min calculated for 0.913 af (96% of inflow)
Center-of-Mass det. time= 134.7 min (921.9 - 787.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	247.00'	0.106 af	**Galley 4x4x4.25** x 100 Inside #2 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
#2A	246.00'	0.064 af	**26.50'W x 82.00'L x 6.75'H Field A** 0.337 af Overall - 0.143 af Embedded = 0.194 af x 33.0% Voids
		0.170 af	Total Available Storage

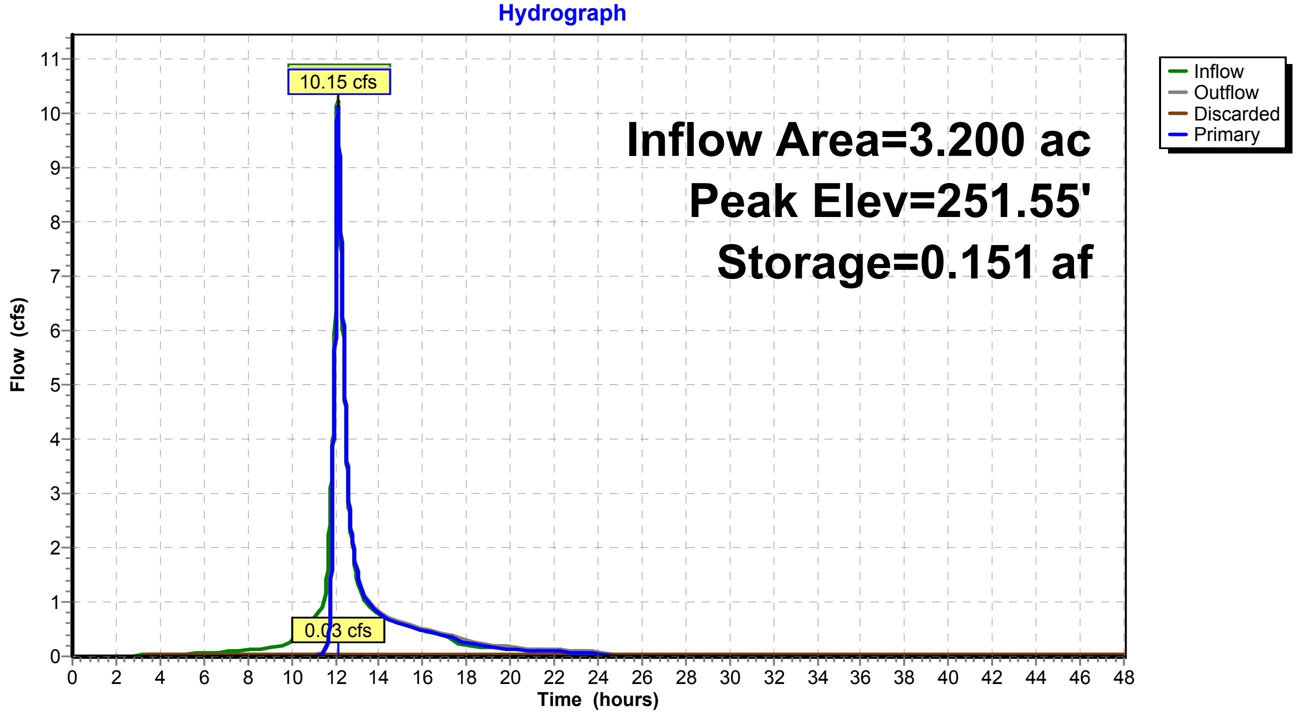
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.00'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	249.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	246.00'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=251.55' (Free Discharge)
└─**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=10.14 cfs @ 12.12 hrs HW=251.55' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 5.20 cfs @ 2.43 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 4.37 cfs @ 4.37 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.58 cfs @ 6.61 fps)

Pond 7P: Galley



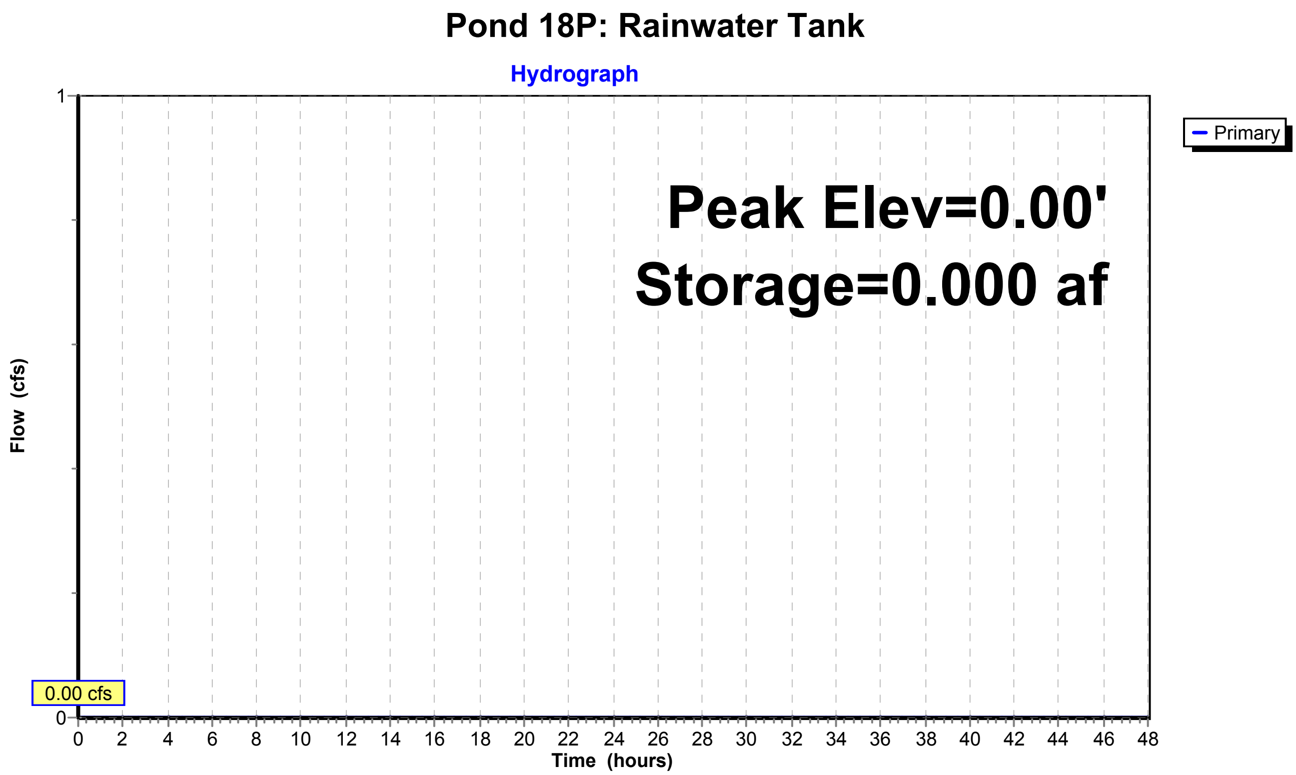
Summary for Pond 18P: Rainwater Tank

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	248.50'	0.038 af	**90.0" Round Pipe Storage** L= 37.5'

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)

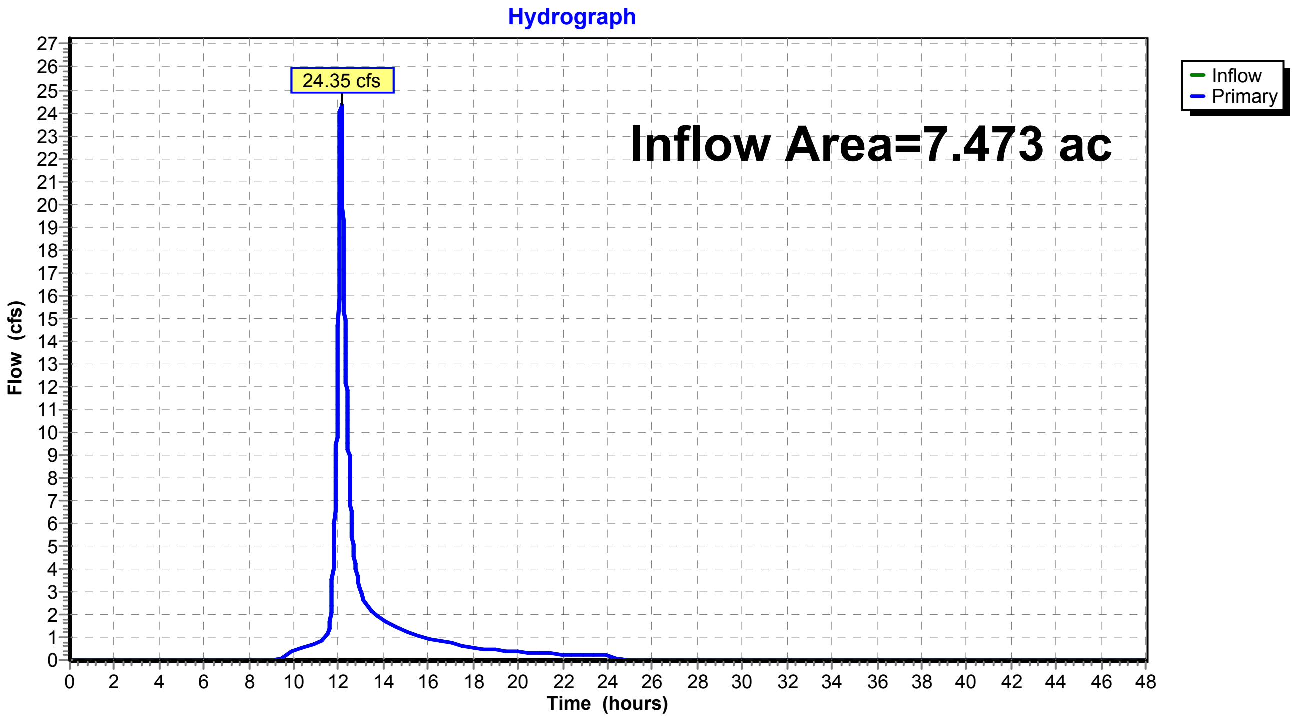


Summary for Link DP1: Reservoir

Inflow Area = 7.473 ac, 67.65% Impervious, Inflow Depth = 2.95" for 10-year event
Inflow = 24.35 cfs @ 12.10 hrs, Volume= 1.835 af
Primary = 24.35 cfs @ 12.10 hrs, Volume= 1.835 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP1: Reservoir

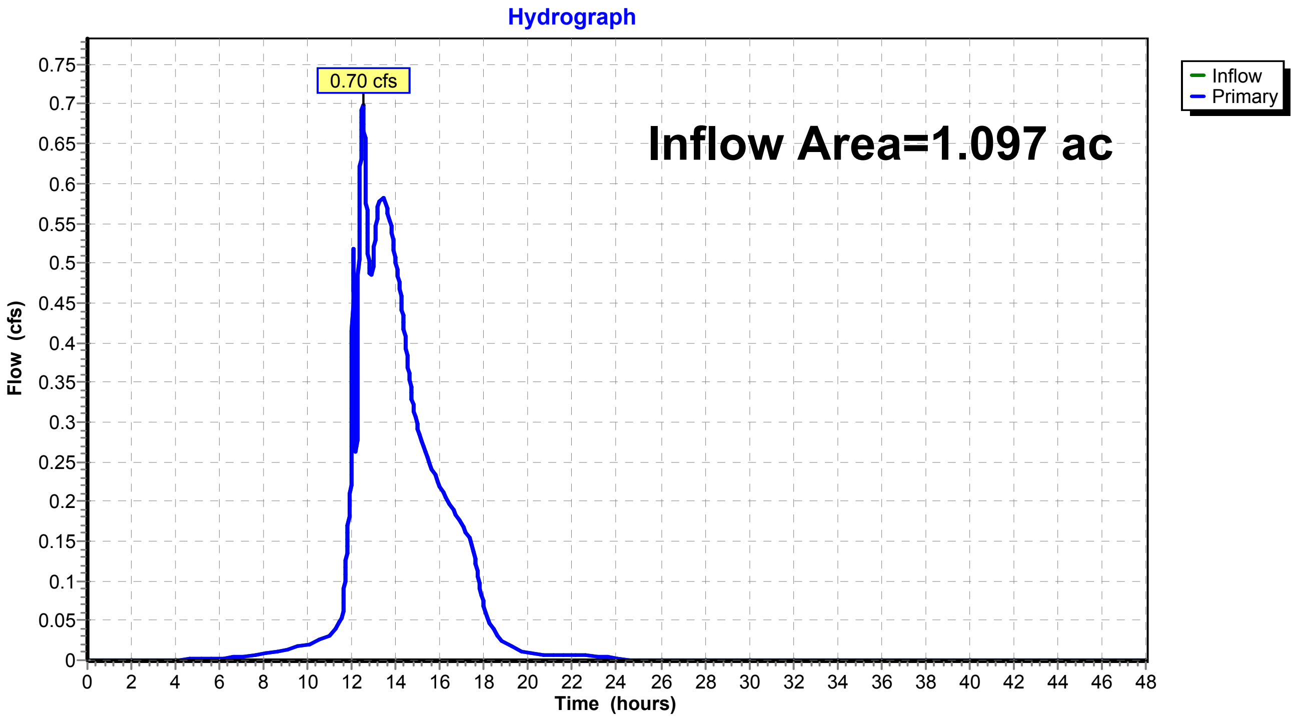


Summary for Link DP2: Penn Avenue

Inflow Area =	1.097 ac, 66.97% Impervious, Inflow Depth = 2.05"	for 10-year event	
Inflow =	0.70 cfs @ 12.50 hrs, Volume=	0.188 af	
Primary =	0.70 cfs @ 12.50 hrs, Volume=	0.188 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP2: Penn Avenue

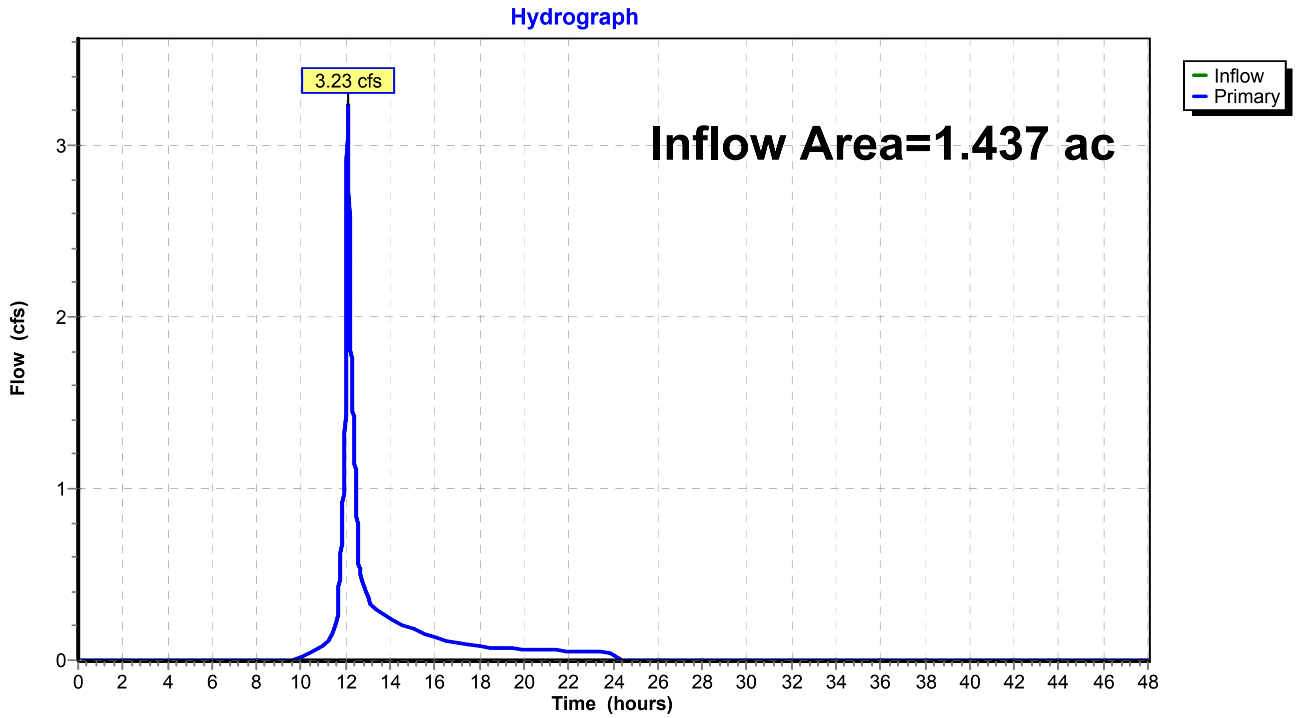


Summary for Link DP3: Swale (Existing)

Inflow Area =	1.437 ac,	0.00% Impervious,	Inflow Depth = 1.97"	for 10-year event
Inflow =	3.23 cfs @	12.10 hrs, Volume=	0.236 af	
Primary =	3.23 cfs @	12.10 hrs, Volume=	0.236 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP3: Swale (Existing)

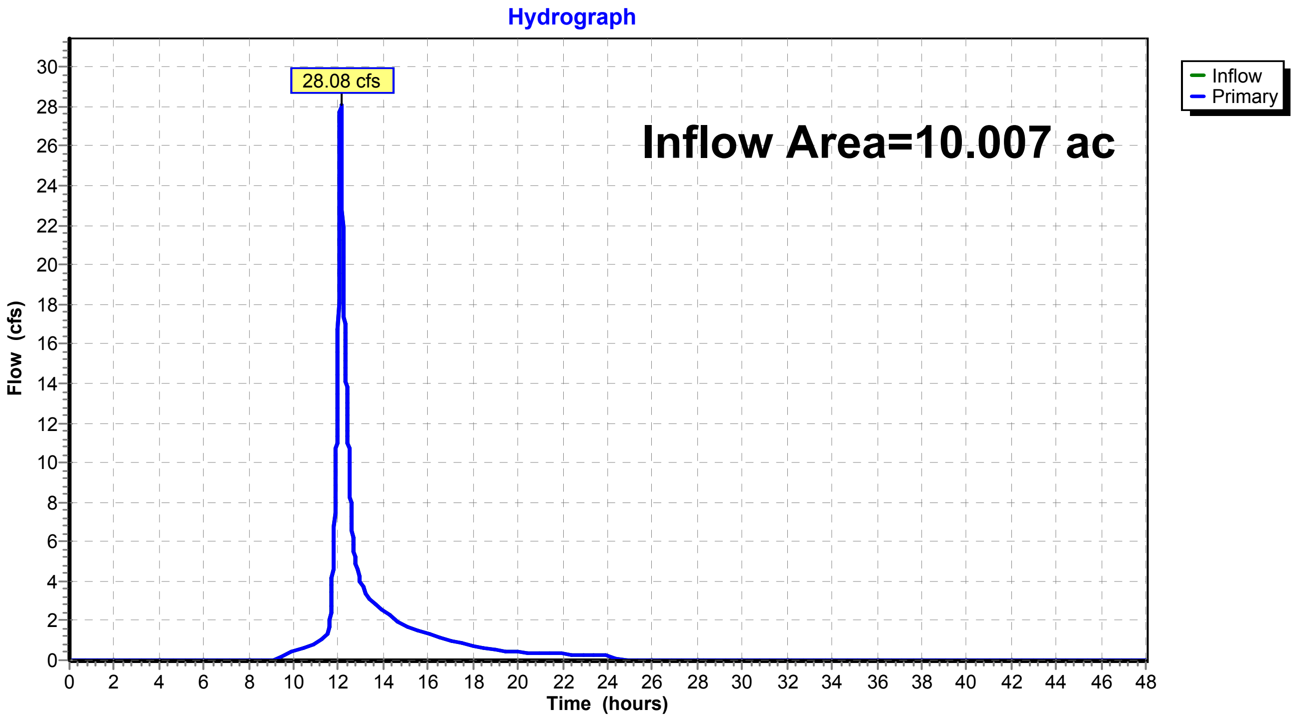


Summary for Link Site: Total Site

Inflow Area = 10.007 ac, 57.86% Impervious, Inflow Depth = 2.71" for 10-year event
Inflow = 28.08 cfs @ 12.10 hrs, Volume= 2.259 af
Primary = 28.08 cfs @ 12.10 hrs, Volume= 2.259 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

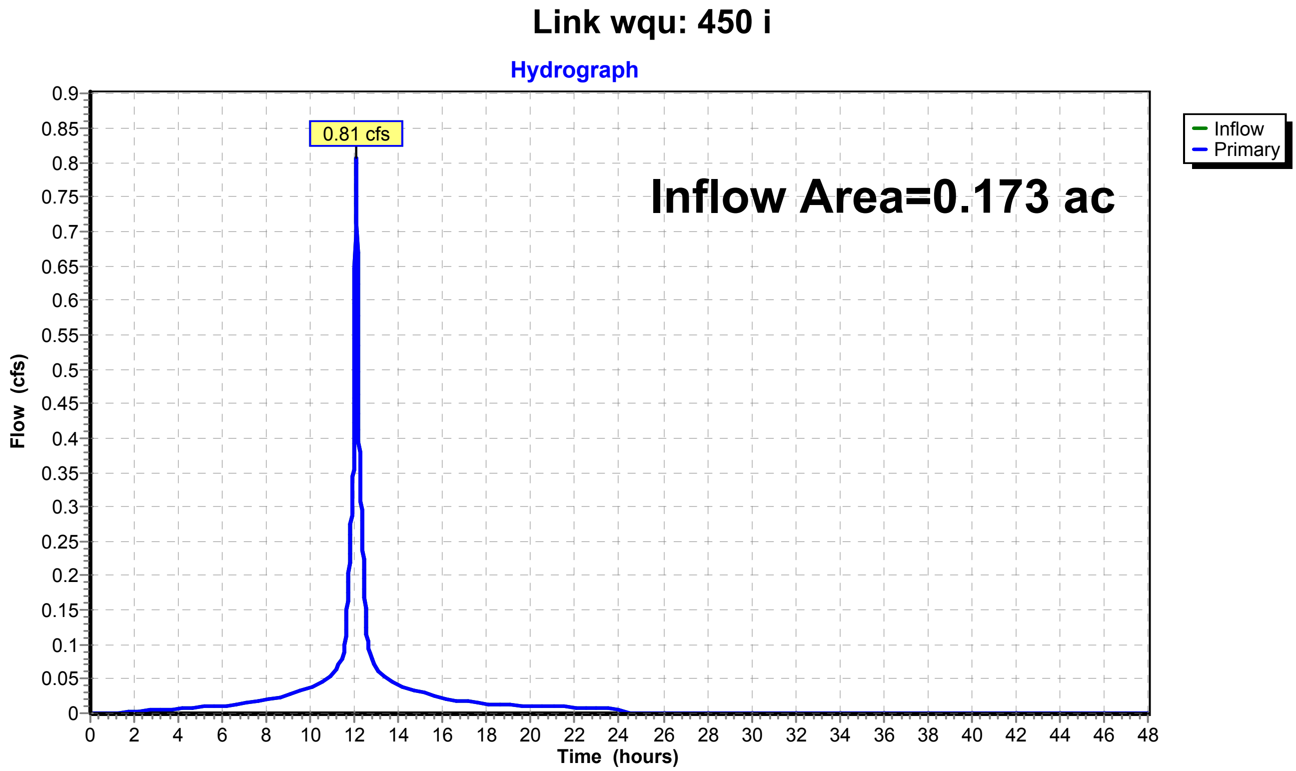
Link Site: Total Site



Summary for Link wqu: 450 i

Inflow Area =	0.173 ac,100.00% Impervious,	Inflow Depth = 4.36"	for 10-year event	
Inflow =	0.81 cfs @	12.07 hrs, Volume=	0.063 af	
Primary =	0.81 cfs @	12.07 hrs, Volume=	0.063 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Building Runoff Area=55,869 sf 100.00% Impervious Runoff Depth=5.26"
Tc=10.0 min CN=98 Runoff=6.06 cfs 0.562 af

Subcatchment2: Back Lot/LA Runoff Area=31,419 sf 67.58% Impervious Runoff Depth=4.36"
Tc=5.0 min CN=90 Runoff=3.66 cfs 0.262 af

Subcatchment3: Paved Lot/LA Runoff Area=44,557 sf 91.54% Impervious Runoff Depth=5.03"
Tc=5.0 min CN=96 Runoff=5.63 cfs 0.429 af

Subcatchment4: Paved Lot/LA Runoff Area=49,545 sf 68.78% Impervious Runoff Depth=4.47"
Tc=5.0 min CN=91 Runoff=5.87 cfs 0.424 af

Subcatchment5: Paved Lot/LA Runoff Area=65,440 sf 92.74% Impervious Runoff Depth=5.03"
Tc=5.0 min CN=96 Runoff=8.27 cfs 0.630 af

Subcatchment6: LA South Runoff Area=71,141 sf 0.00% Impervious Runoff Depth=2.77"
Flow Length=550' Tc=9.6 min CN=74 Runoff=4.68 cfs 0.377 af

Subcatchment7: Building Runoff Area=27,935 sf 100.00% Impervious Runoff Depth=5.26"
Tc=10.0 min CN=98 Runoff=3.03 cfs 0.281 af

Subcatchment8: LA Area Runoff Area=14,620 sf 0.00% Impervious Runoff Depth=2.77"
Flow Length=50' Slope=0.0100 '/' Tc=7.4 min CN=74 Runoff=1.04 cfs 0.077 af

Subcatchment9: Paved Lot Runoff Area=5,216 sf 77.76% Impervious Runoff Depth=4.69"
Tc=5.0 min CN=93 Runoff=0.64 cfs 0.047 af

Subcatchment10: Wooded Area Runoff Area=62,614 sf 0.00% Impervious Runoff Depth=2.68"
Flow Length=470' Tc=6.4 min CN=73 Runoff=4.44 cfs 0.321 af

Subcatchment11: Paved Lot Runoff Area=7,547 sf 100.00% Impervious Runoff Depth=5.26"
Tc=5.0 min CN=98 Runoff=0.97 cfs 0.076 af

Pond 1P: Surface Detention Peak Elev=255.69' Storage=4,307 cf Inflow=4.04 cfs 0.359 af
Primary=0.62 cfs 0.036 af Secondary=0.87 cfs 0.323 af Outflow=1.50 cfs 0.359 af

Pond 2P: Surface Detention Peak Elev=254.85' Storage=4,378 cf Inflow=9.19 cfs 0.825 af
Primary=5.25 cfs 0.178 af Secondary=2.52 cfs 0.646 af Outflow=7.77 cfs 0.825 af

Pond 4P: Stone Storage Peak Elev=250.92' Storage=3,090 cf Inflow=0.87 cfs 0.323 af
Discarded=0.07 cfs 0.149 af Primary=0.64 cfs 0.173 af Outflow=0.72 cfs 0.323 af

Pond 5P: Galley Peak Elev=229.03' Storage=3,952 cf Inflow=14.14 cfs 1.053 af
Discarded=0.02 cfs 0.076 af Primary=14.06 cfs 0.961 af Outflow=14.08 cfs 1.037 af

Pond 6P: Stone Storage Peak Elev=251.73' Storage=2,477 cf Inflow=2.52 cfs 0.646 af
Discarded=0.05 cfs 0.142 af Primary=2.48 cfs 0.517 af Outflow=2.53 cfs 0.660 af

Pond 7P: Galley Peak Elev=251.69' Storage=0.153 af Inflow=12.73 cfs 1.201 af
Discarded=0.03 cfs 0.126 af Primary=12.64 cfs 1.036 af Outflow=12.67 cfs 1.161 af

Pond 18P: Rainwater Tank Peak Elev=0.00' Storage=0.000 af
Primary=0.00 cfs 0.000 af

Link DP1: Reservoir Inflow=30.42 cfs 2.374 af
Primary=30.42 cfs 2.374 af

Link DP2: Penn Avenue Inflow=1.10 cfs 0.256 af
Primary=1.10 cfs 0.256 af

Link DP3: Swale (Existing) Inflow=4.44 cfs 0.321 af
Primary=4.44 cfs 0.321 af

Link Site: Total Site Inflow=35.46 cfs 2.951 af
Primary=35.46 cfs 2.951 af

Link wqu: 450 i Inflow=0.97 cfs 0.076 af
Primary=0.97 cfs 0.076 af

Total Runoff Area = 10.007 ac Runoff Volume = 3.486 af Average Runoff Depth = 4.18"
42.14% Pervious = 4.217 ac 57.86% Impervious = 5.790 ac

Summary for Subcatchment 1: Building

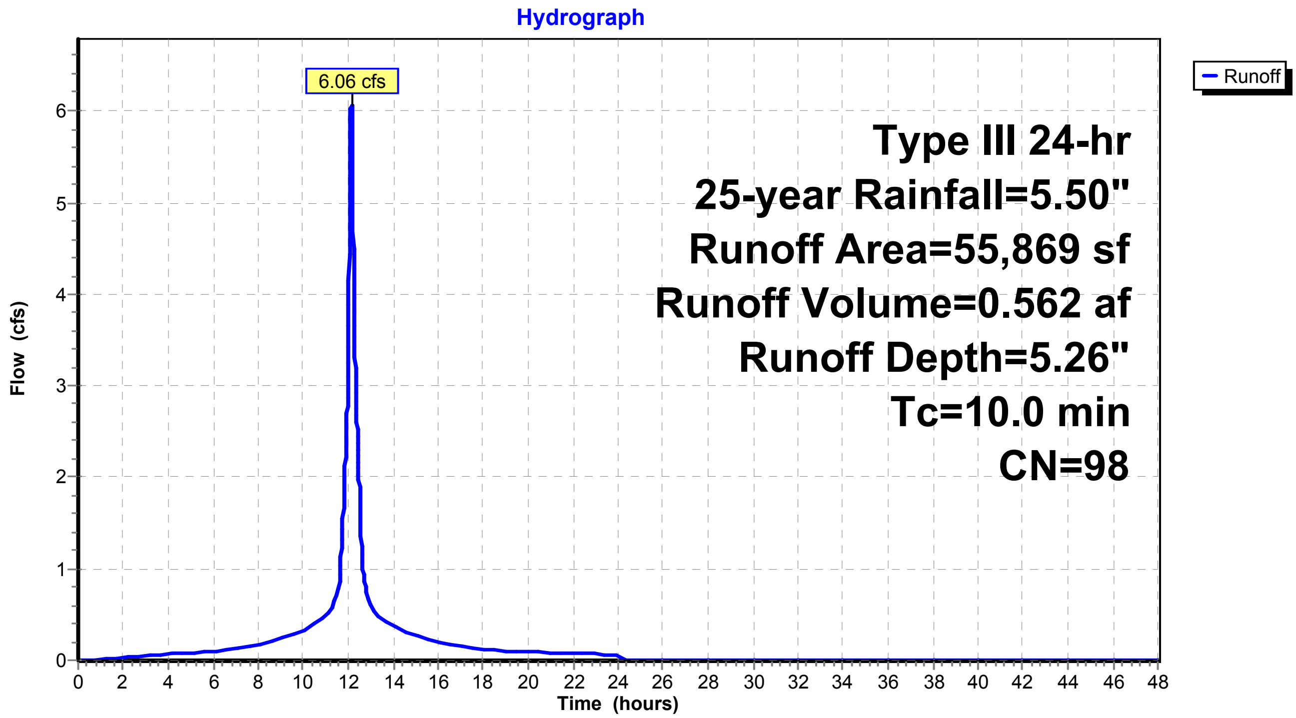
Runoff = 6.06 cfs @ 12.13 hrs, Volume= 0.562 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
55,869	98	Roofs, HSG C
55,869		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1: Building



Summary for Subcatchment 2: Back Lot/LA

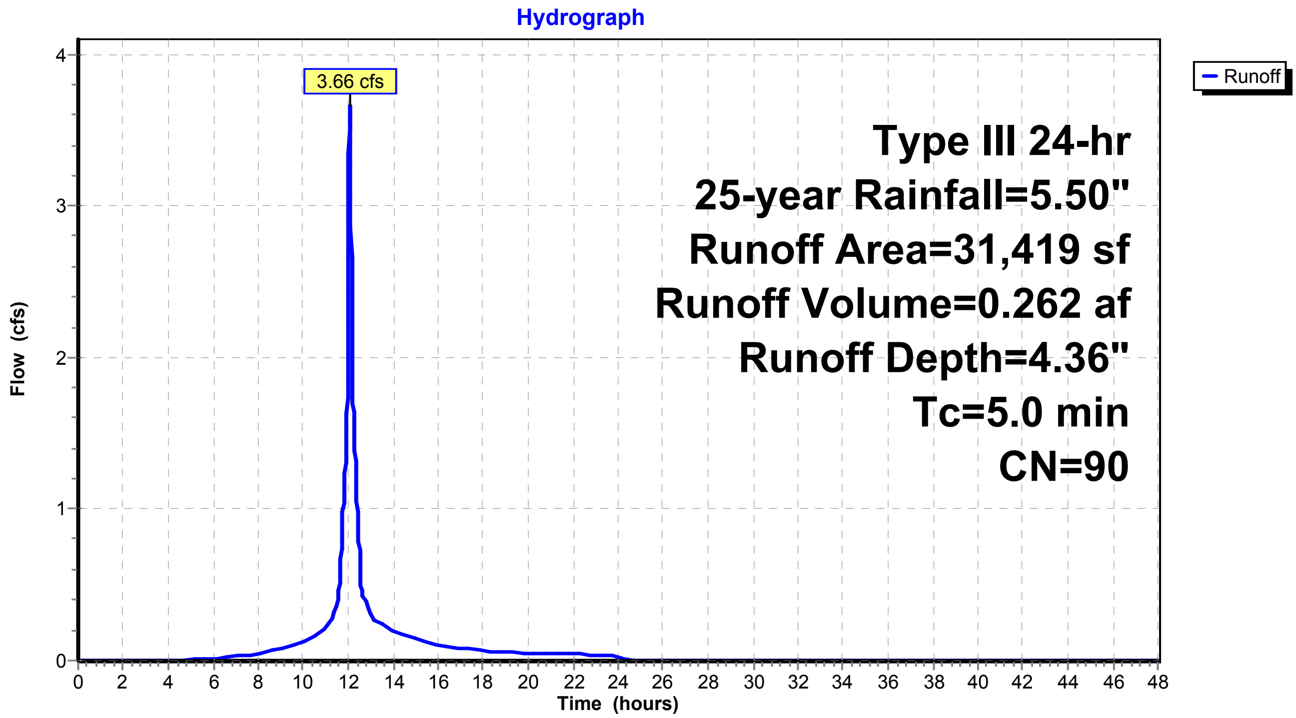
Runoff = 3.66 cfs @ 12.07 hrs, Volume= 0.262 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
21,234	98	Paved parking, HSG C
10,185	74	>75% Grass cover, Good, HSG C
31,419	90	Weighted Average
10,185		32.42% Pervious Area
21,234		67.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Back Lot/LA



Summary for Subcatchment 3: Paved Lot/LA

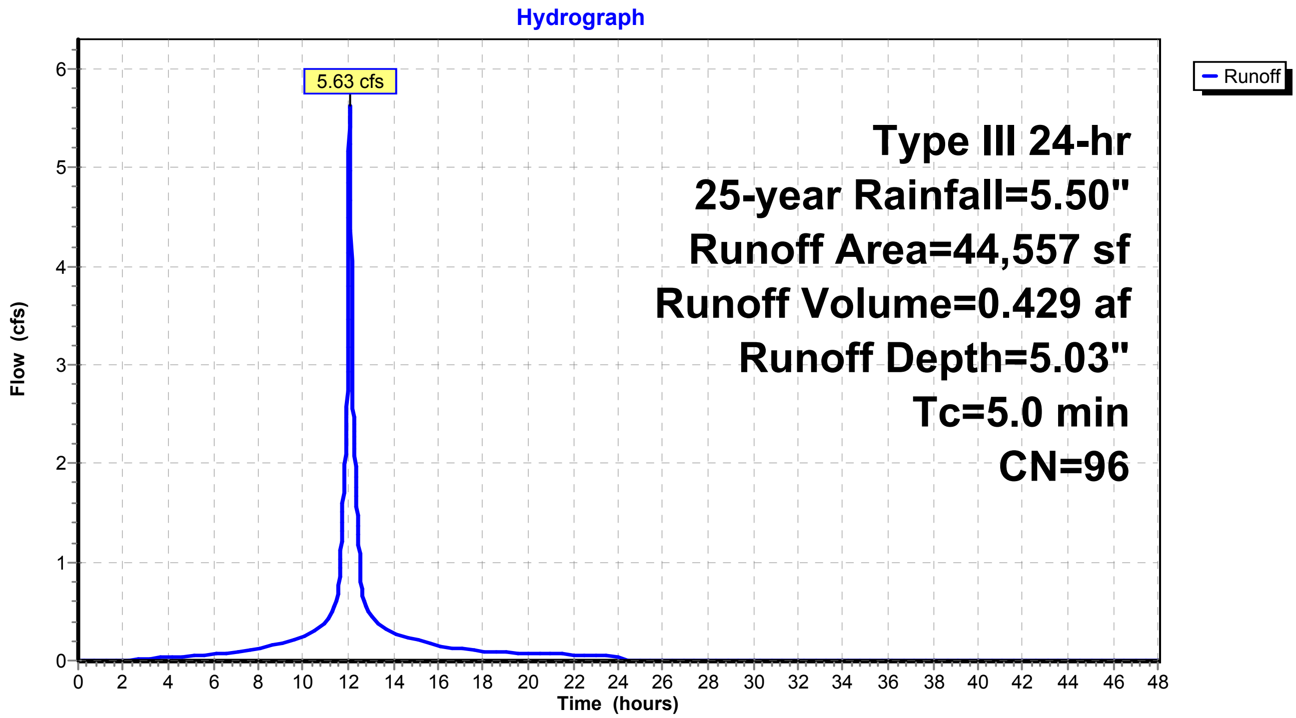
Runoff = 5.63 cfs @ 12.07 hrs, Volume= 0.429 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
40,788	98	Paved parking, HSG C
3,769	74	>75% Grass cover, Good, HSG C
44,557	96	Weighted Average
3,769		8.46% Pervious Area
40,788		91.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Paved Lot/LA



Summary for Subcatchment 4: Paved Lot/LA

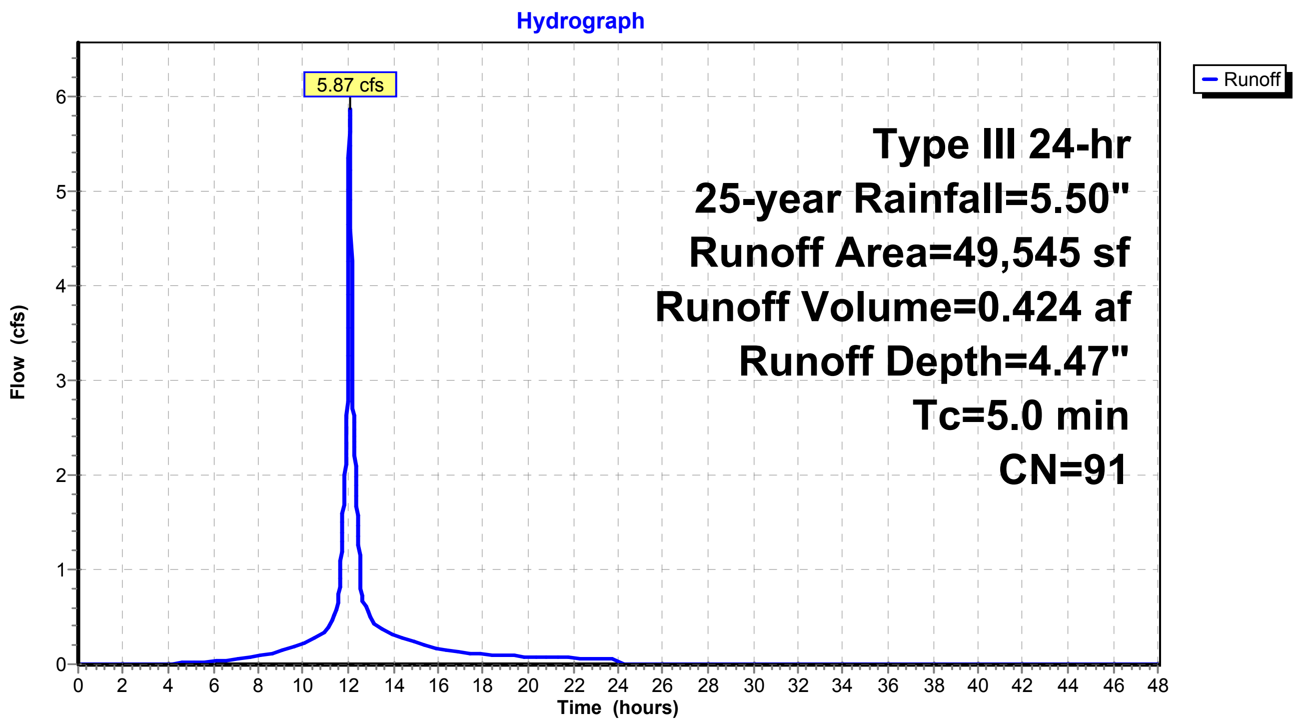
Runoff = 5.87 cfs @ 12.07 hrs, Volume= 0.424 af, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

	Area (sf)	CN	Description
	34,076	98	Paved parking, HSG C
*	3,279	74	>75% Grass cover, Good, HSG C/Int LA
*	12,190	74	>75% Grass cover, Good, HSG C/LA north
	49,545	91	Weighted Average
	15,469		31.22% Pervious Area
	34,076		68.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Paved Lot/LA



Summary for Subcatchment 5: Paved Lot/LA

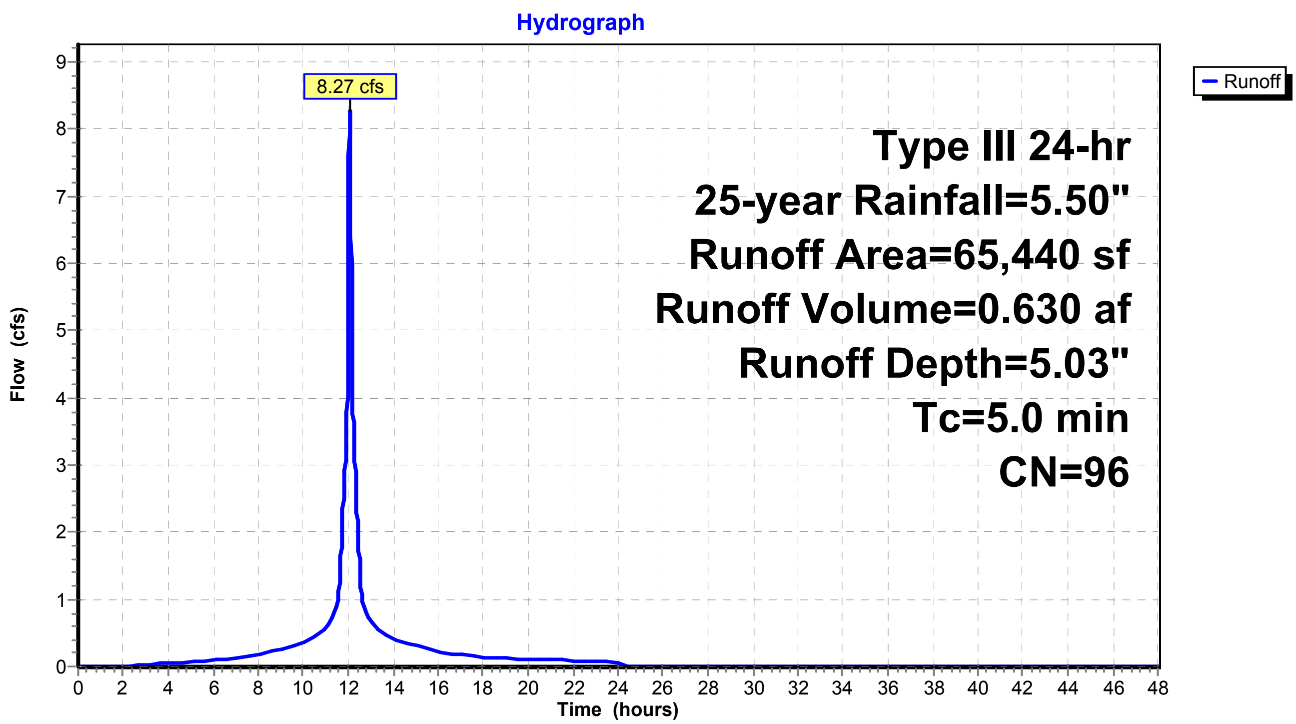
Runoff = 8.27 cfs @ 12.07 hrs, Volume= 0.630 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
60,688	98	Paved parking, HSG C
4,752	74	>75% Grass cover, Good, HSG C
65,440	96	Weighted Average
4,752		7.26% Pervious Area
60,688		92.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Paved Lot/LA



Summary for Subcatchment 6: LA South

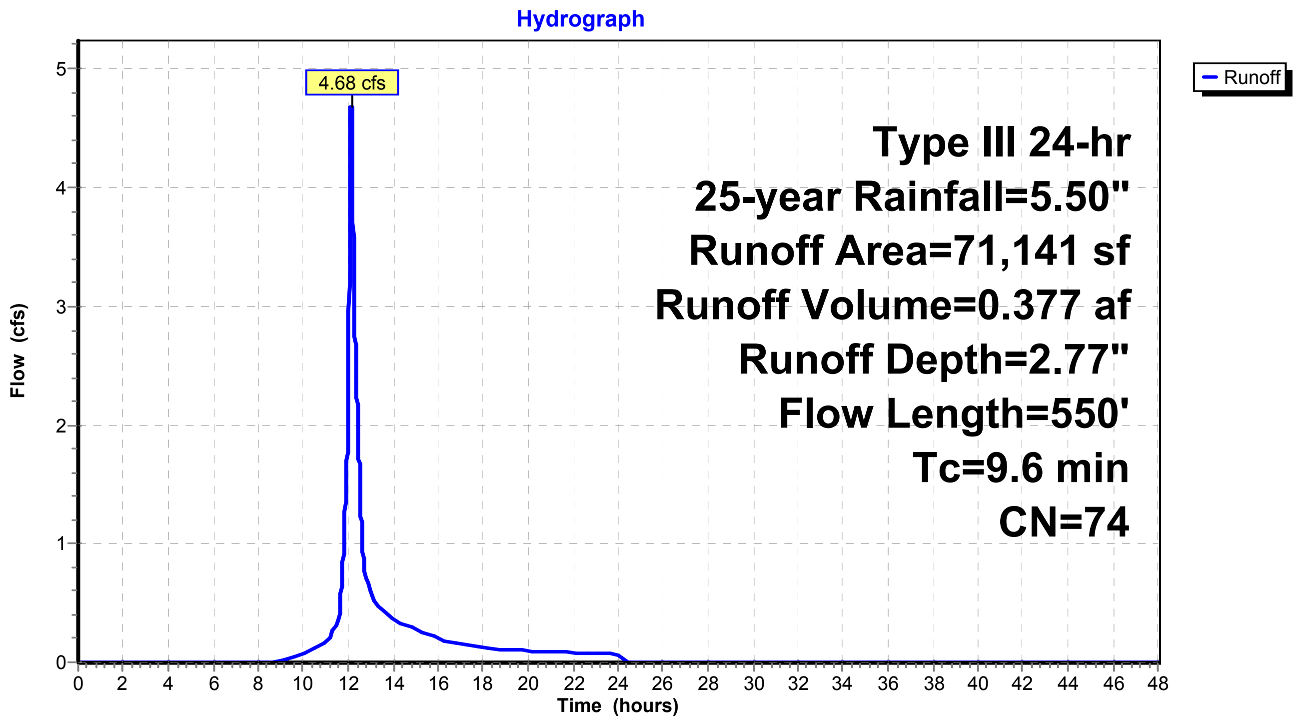
Runoff = 4.68 cfs @ 12.14 hrs, Volume= 0.377 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
71,141	74	>75% Grass cover, Good, HSG C
71,141		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	50	0.1000	0.28		**Sheet Flow, Grass/Wooded Area** Grass: Short n= 0.150 P2= 3.20"
6.0	400	0.0500	1.12		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
0.6	100	0.3000	2.74		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
9.6	550	Total			

Subcatchment 6: LA South



Summary for Subcatchment 7: Building

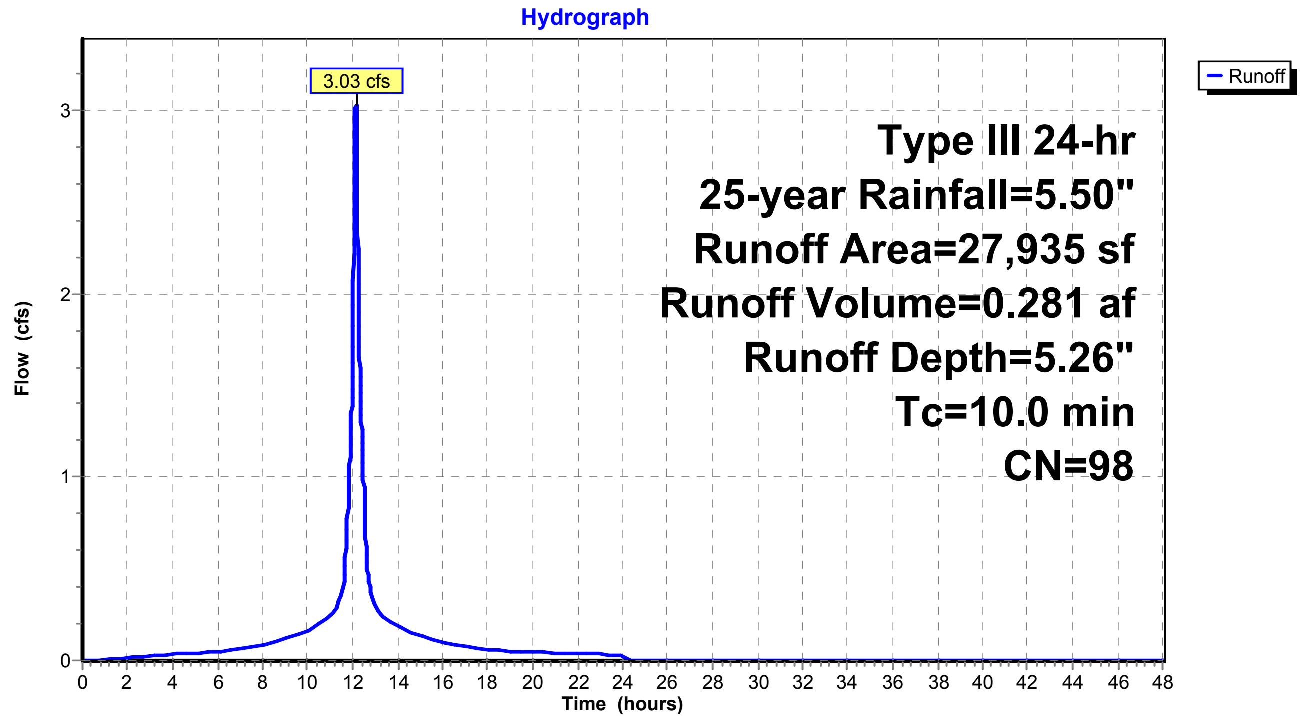
Runoff = 3.03 cfs @ 12.13 hrs, Volume= 0.281 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
27,935	98	Roofs, HSG C
27,935		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 7: Building



Summary for Subcatchment 8: LA Area

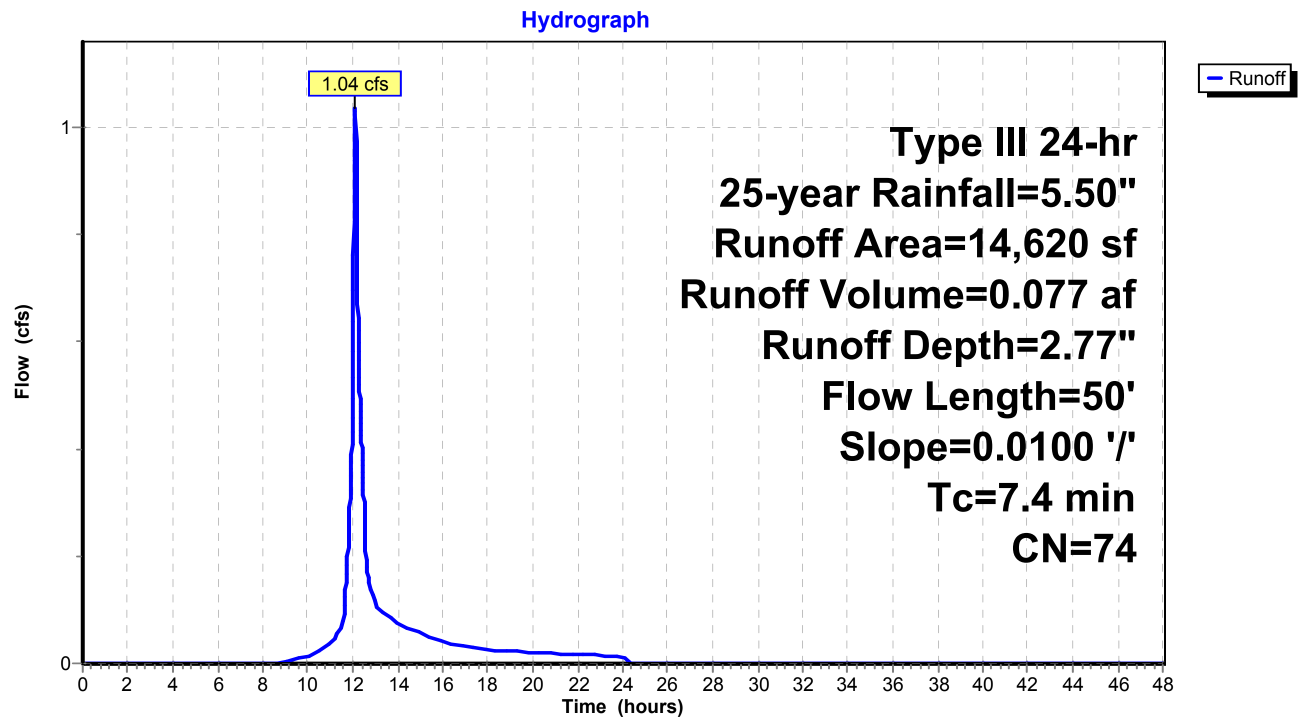
Runoff = 1.04 cfs @ 12.11 hrs, Volume= 0.077 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
14,620	74	>75% Grass cover, Good, HSG C
14,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, Grass Area** Grass: Short n= 0.150 P2= 3.20"

Subcatchment 8: LA Area



Summary for Subcatchment 9: Paved Lot

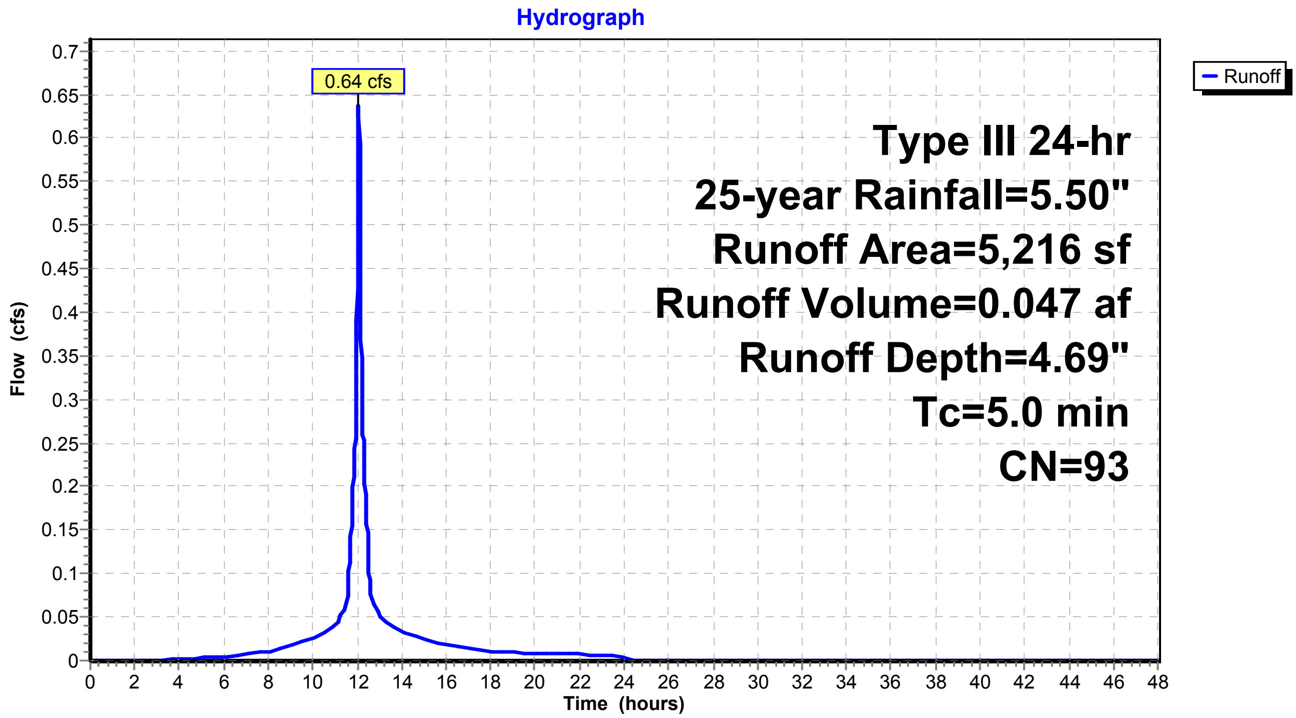
Runoff = 0.64 cfs @ 12.07 hrs, Volume= 0.047 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

	Area (sf)	CN	Description
*	4,056	98	Paved Driveway, HSG C
	1,160	74	>75% Grass cover, Good, HSG C
	5,216	93	Weighted Average
	1,160		22.24% Pervious Area
	4,056		77.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9: Paved Lot



Summary for Subcatchment 10: Wooded Area

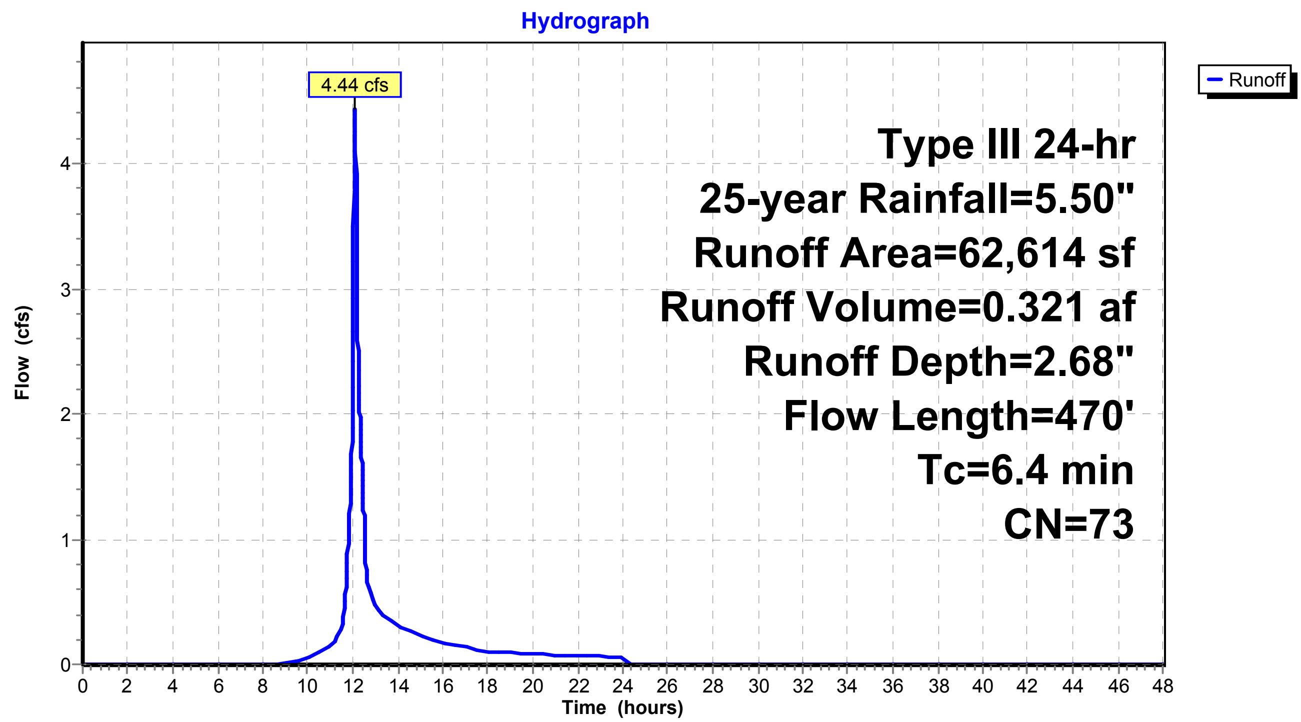
Runoff = 4.44 cfs @ 12.10 hrs, Volume= 0.321 af, Depth= 2.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
62,614	73	Woods, Fair, HSG C
62,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.3000	0.20		**Sheet Flow, Wooded Area** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
6.4	470	Total			

Subcatchment 10: Wooded Area



Summary for Subcatchment 11: Paved Lot

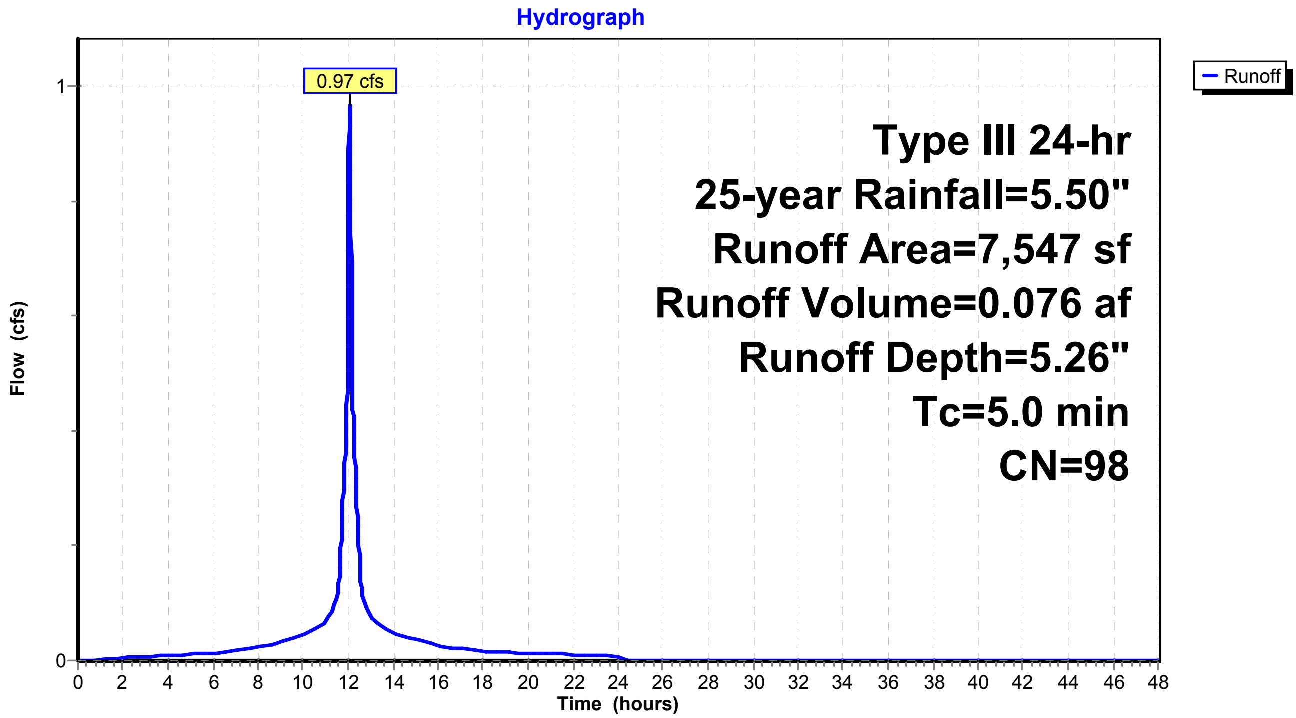
Runoff = 0.97 cfs @ 12.07 hrs, Volume= 0.076 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=5.50"

Area (sf)	CN	Description
7,547	98	Paved parking, HSG C
7,547		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11: Paved Lot



Summary for Pond 1P: Surface Detention

Inflow Area = 0.977 ac, 65.64% Impervious, Inflow Depth = 4.41" for 25-year event
Inflow = 4.04 cfs @ 12.12 hrs, Volume= 0.359 af
Outflow = 1.50 cfs @ 12.44 hrs, Volume= 0.359 af, Atten= 63%, Lag= 18.6 min
Primary = 0.62 cfs @ 12.44 hrs, Volume= 0.036 af
Secondary = 0.87 cfs @ 12.44 hrs, Volume= 0.323 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 255.69' @ 12.44 hrs Surf.Area= 3,612 sf Storage= 4,307 cf
Flood Elev= 257.00' Surf.Area= 5,368 sf Storage= 10,203 cf

Plug-Flow detention time= 40.2 min calculated for 0.359 af (100% of inflow)
Center-of-Mass det. time= 40.2 min (808.5 - 768.3)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	10,203 cf	**Surface Detention (Irregular)** Listed below (Recalc)

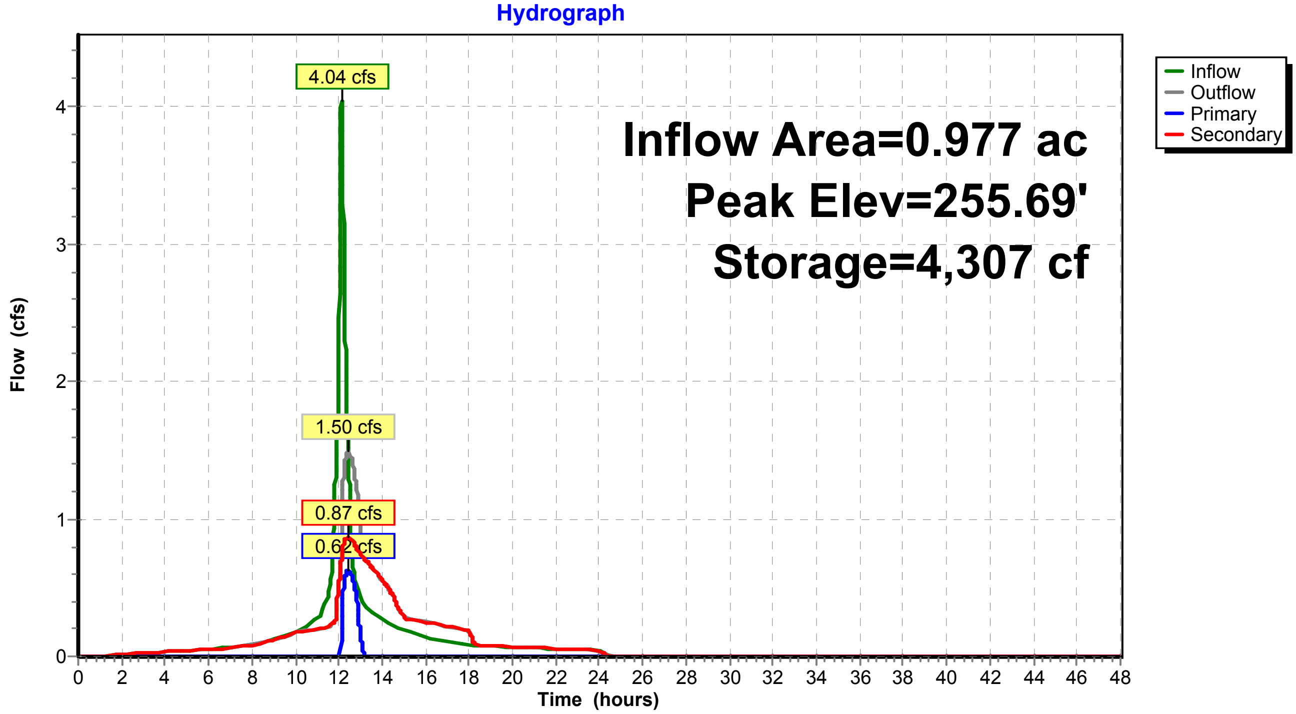
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
254.00	1,548	396.2	0	0	1,548
255.00	2,764	415.0	2,127	2,127	2,828
256.00	4,038	433.9	3,381	5,508	4,173
256.50	4,696	443.3	2,181	7,689	4,865
257.00	5,368	452.7	2,514	10,203	5,572

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	255.25'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	254.60'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	254.00'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=0.62 cfs @ 12.44 hrs HW=255.69' (Free Discharge)
↑—**1=Orifice/Grate** (Controls 0.00 cfs)
└—**2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 3.18 fps)

Secondary OutFlow Max=0.87 cfs @ 12.44 hrs HW=255.69' (Free Discharge)
↑—**3=Orifice/Grate** (Orifice Controls 0.44 cfs @ 5.02 fps)
└—**4=Exfiltration** (Exfiltration Controls 0.43 cfs)

Pond 1P: Surface Detention



Summary for Pond 2P: Surface Detention

Inflow Area = 2.004 ac, 88.33% Impervious, Inflow Depth = 4.94" for 25-year event
Inflow = 9.19 cfs @ 12.10 hrs, Volume= 0.825 af
Outflow = 7.77 cfs @ 12.17 hrs, Volume= 0.825 af, Atten= 15%, Lag= 4.2 min
Primary = 5.25 cfs @ 12.17 hrs, Volume= 0.178 af
Secondary = 2.52 cfs @ 12.17 hrs, Volume= 0.646 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 254.85' @ 12.17 hrs Surf.Area= 4,007 sf Storage= 4,378 cf

Plug-Flow detention time= 17.2 min calculated for 0.824 af (100% of inflow)
Center-of-Mass det. time= 17.2 min (779.0 - 761.8)

Volume	Invert	Avail.Storage	Storage Description
#1	253.50'	9,744 cf	**Surface Detention (Irregular)** Listed below (Recalc)

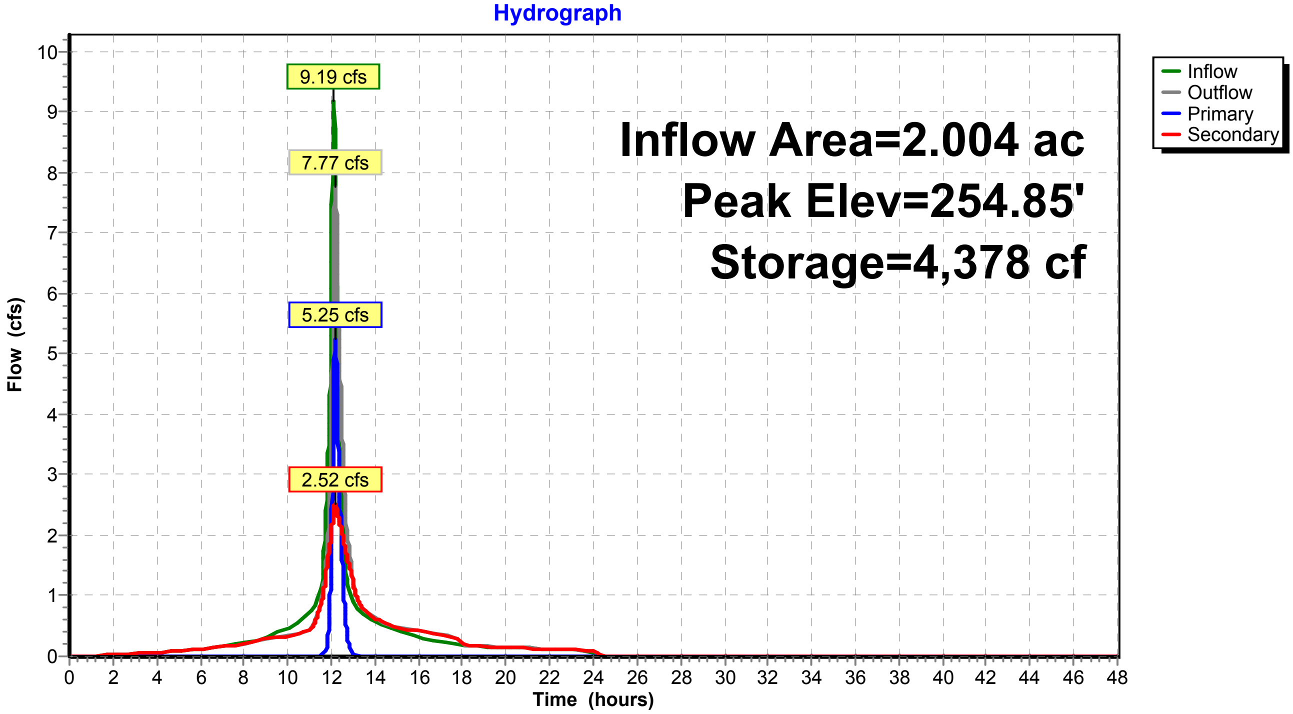
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.50	2,486	280.0	0	0	2,486
254.00	3,039	317.8	1,379	1,379	4,290
255.00	4,186	386.5	3,597	4,976	8,157
256.00	5,374	405.3	4,768	9,744	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	254.33'	**18.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	254.16'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	254.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	253.90'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	253.50'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=5.25 cfs @ 12.17 hrs HW=254.85' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Orifice/Grate (Orifice Controls 1.35 cfs @ 2.46 fps)
3=Orifice/Grate (Orifice Controls 1.65 cfs @ 2.84 fps)
4=Orifice/Grate (Orifice Controls 2.25 cfs @ 3.15 fps)

Secondary OutFlow Max=2.51 cfs @ 12.17 hrs HW=254.85' (Free Discharge)
5=Orifice/Grate (Orifice Controls 1.64 cfs @ 4.70 fps)
6=Exfiltration (Exfiltration Controls 0.87 cfs)

Pond 2P: Surface Detention



Summary for Pond 4P: Stone Storage

Inflow	=	0.87 cfs @	12.44 hrs,	Volume=	0.323 af
Outflow	=	0.72 cfs @	13.13 hrs,	Volume=	0.323 af, Atten= 18%, Lag= 41.6 min
Discarded	=	0.07 cfs @	13.13 hrs,	Volume=	0.149 af
Primary	=	0.64 cfs @	13.13 hrs,	Volume=	0.173 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 250.92' @ 13.13 hrs Surf.Area= 3,771 sf Storage= 3,090 cf

Plug-Flow detention time= 157.7 min calculated for 0.323 af (100% of inflow)
Center-of-Mass det. time= 157.8 min (972.6 - 814.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	250.50'	583 cf	**ADS N-12 12** x 36 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	4,367 cf	**20.84'W x 181.00'L x 3.71'H Field A** 13,987 cf Overall - 754 cf Embedded = 13,233 cf x 33.0% Voids
		4,950 cf	Total Available Storage

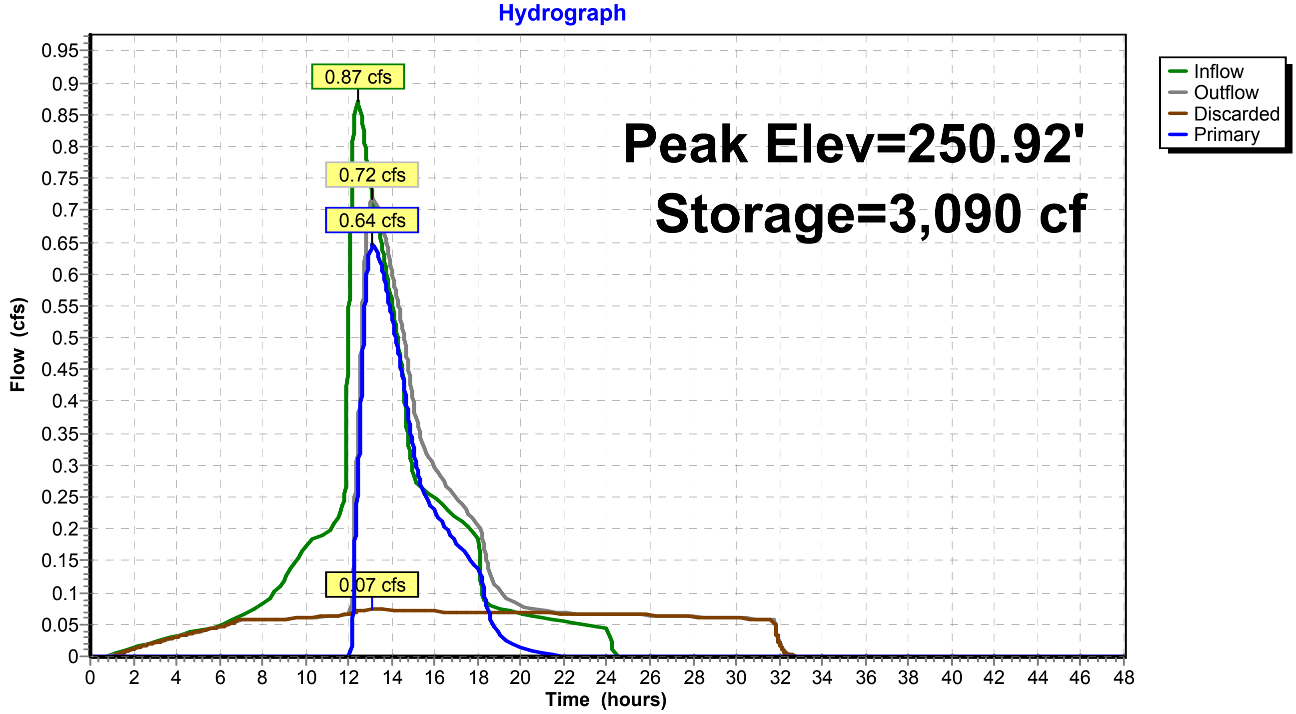
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.50'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	250.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.07 cfs @ 13.13 hrs HW=250.92' (Free Discharge)
└—**4=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.64 cfs @ 13.13 hrs HW=250.92' (Free Discharge)
├—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
├—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.28 cfs @ 1.61 fps)
└—**3=Orifice/Grate** (Orifice Controls 0.36 cfs @ 4.17 fps)

Pond 4P: Stone Storage



Summary for Pond 5P: Galley

Inflow Area =	2.640 ac,	82.41% Impervious,	Inflow Depth = 4.79"	for 25-year event
Inflow =	14.14 cfs @	12.07 hrs, Volume=	1.053 af	
Outflow =	14.08 cfs @	12.08 hrs, Volume=	1.037 af,	Atten= 0%, Lag= 0.4 min
Discarded =	0.02 cfs @	12.08 hrs, Volume=	0.076 af	
Primary =	14.06 cfs @	12.08 hrs, Volume=	0.961 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 229.03' @ 12.08 hrs Surf.Area= 1,300 sf Storage= 3,952 cf

Plug-Flow detention time= 90.5 min calculated for 1.036 af (98% of inflow)
Center-of-Mass det. time= 80.6 min (849.4 - 768.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	224.30'	2,661 cf	**Galley 4x4x4** x 60 Inside #2 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#2A	223.30'	1,623 cf	**26.00'W x 50.00'L x 6.50'H Field A** 8,450 cf Overall - 3,533 cf Embedded = 4,917 cf x 33.0% Voids
		4,283 cf	Total Available Storage

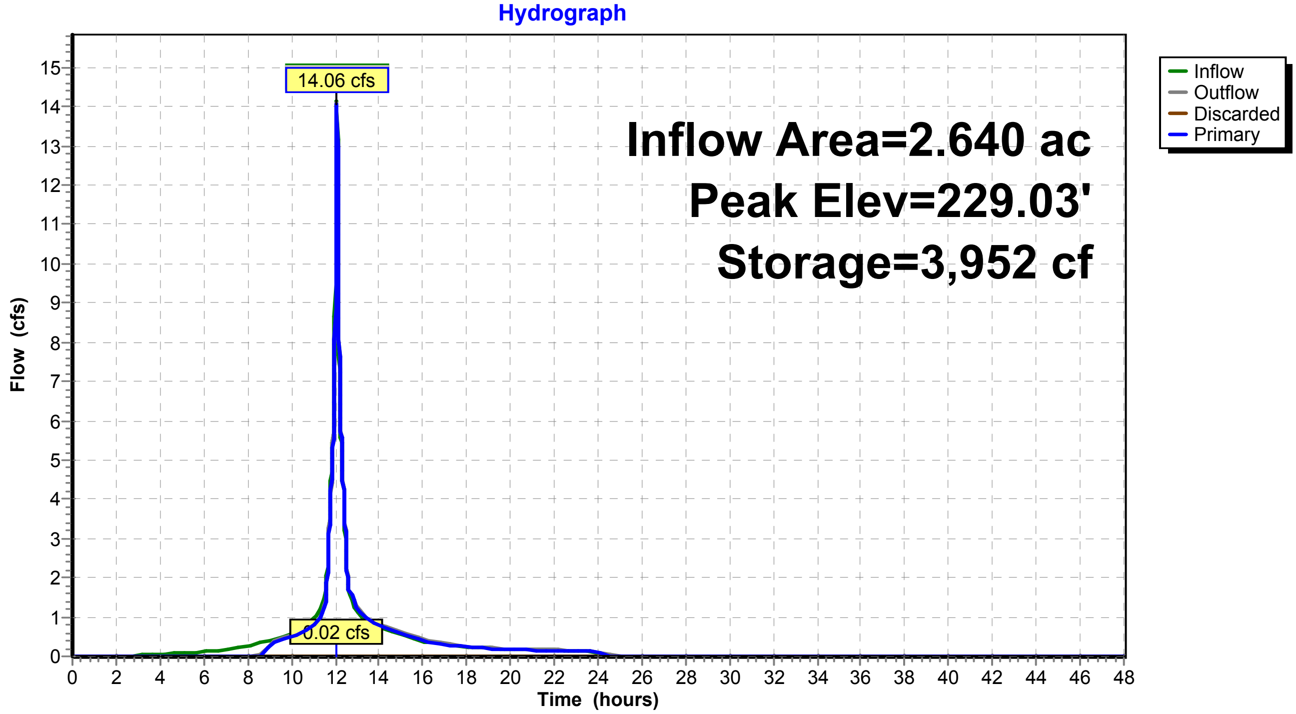
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	228.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	227.30'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	226.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	223.30'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.02 cfs @ 12.08 hrs HW=229.03' (Free Discharge)
└─**4=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=14.04 cfs @ 12.08 hrs HW=229.03' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 7.81 cfs @ 2.79 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 4.80 cfs @ 4.80 fps)
└─**3=Orifice/Grate** (Orifice Controls 1.43 cfs @ 7.27 fps)

Pond 5P: Galley



Summary for Pond 6P: Stone Storage

[93] Warning: Storage range exceeded by 0.52'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow	=	2.52 cfs @	12.17 hrs, Volume=	0.646 af	
Outflow	=	2.53 cfs @	12.17 hrs, Volume=	0.660 af,	Atten= 0%, Lag= 0.0 min
Discarded	=	0.05 cfs @	12.17 hrs, Volume=	0.142 af	
Primary	=	2.48 cfs @	12.17 hrs, Volume=	0.517 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 251.73' @ 12.17 hrs Surf.Area= 2,521 sf Storage= 2,477 cf

Plug-Flow detention time= 94.1 min calculated for 0.646 af (100% of inflow)
Center-of-Mass det. time= 121.2 min (912.2 - 791.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	249.50'	389 cf	**ADS N-12 12** x 24 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	2,088 cf	**20.84'W x 121.00'L x 2.71'H Field A** 6,829 cf Overall - 502 cf Embedded = 6,327 cf x 33.0% Voids
		2,477 cf	Total Available Storage

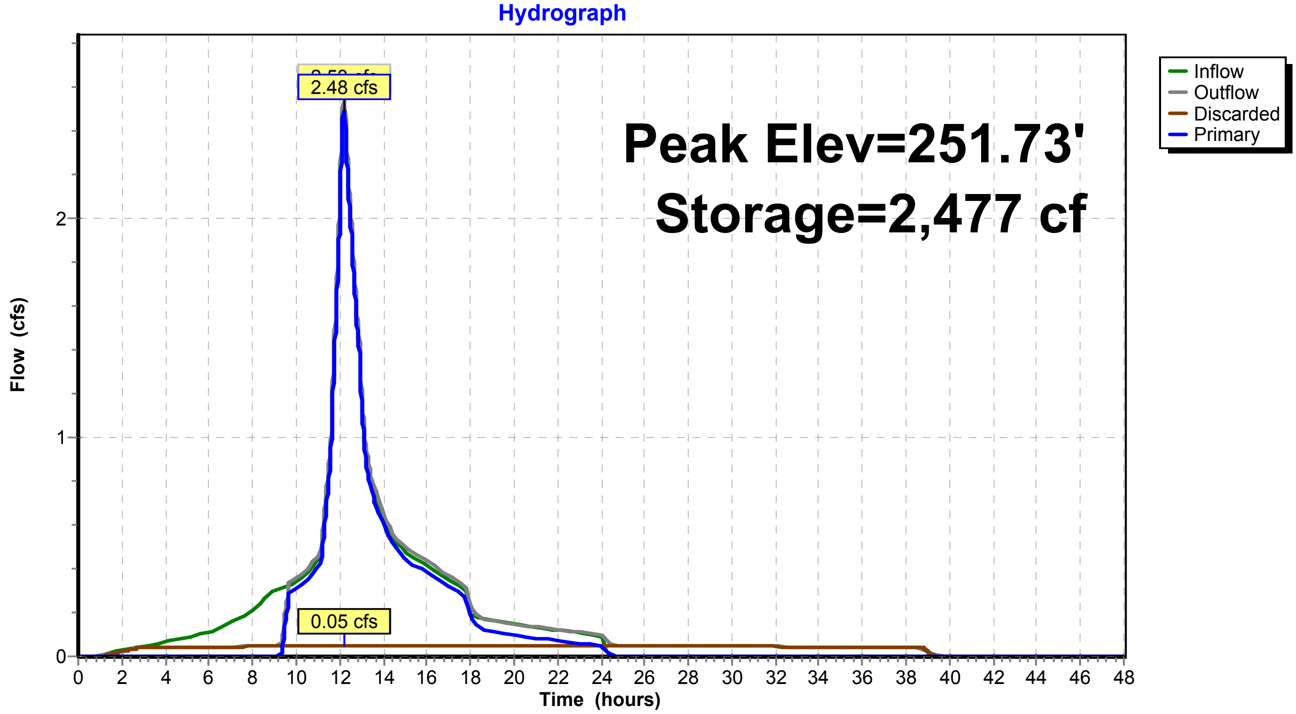
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 12.17 hrs HW=251.73' (Free Discharge)
└─**2=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.48 cfs @ 12.17 hrs HW=251.73' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 2.48 cfs @ 2.91 fps)

Pond 6P: Stone Storage



Summary for Pond 7P: Galley

[79] Warning: Submerged Pond 6P Primary device # 1 by 0.69'

Inflow Area = 3.200 ac, 89.99% Impervious, Inflow Depth = 4.50" for 25-year event
Inflow = 12.73 cfs @ 12.10 hrs, Volume= 1.201 af
Outflow = 12.67 cfs @ 12.12 hrs, Volume= 1.161 af, Atten= 0%, Lag= 0.7 min
Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.126 af
Primary = 12.64 cfs @ 12.12 hrs, Volume= 1.036 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 251.69' @ 12.12 hrs Surf.Area= 0.050 ac Storage= 0.153 af

Plug-Flow detention time= 130.2 min calculated for 1.161 af (97% of inflow)
Center-of-Mass det. time= 111.9 min (896.3 - 784.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	247.00'	0.106 af	**Galley 4x4x4.25** x 100 Inside #2 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
#2A	246.00'	0.064 af	**26.50'W x 82.00'L x 6.75'H Field A** 0.337 af Overall - 0.143 af Embedded = 0.194 af x 33.0% Voids
		0.170 af	Total Available Storage

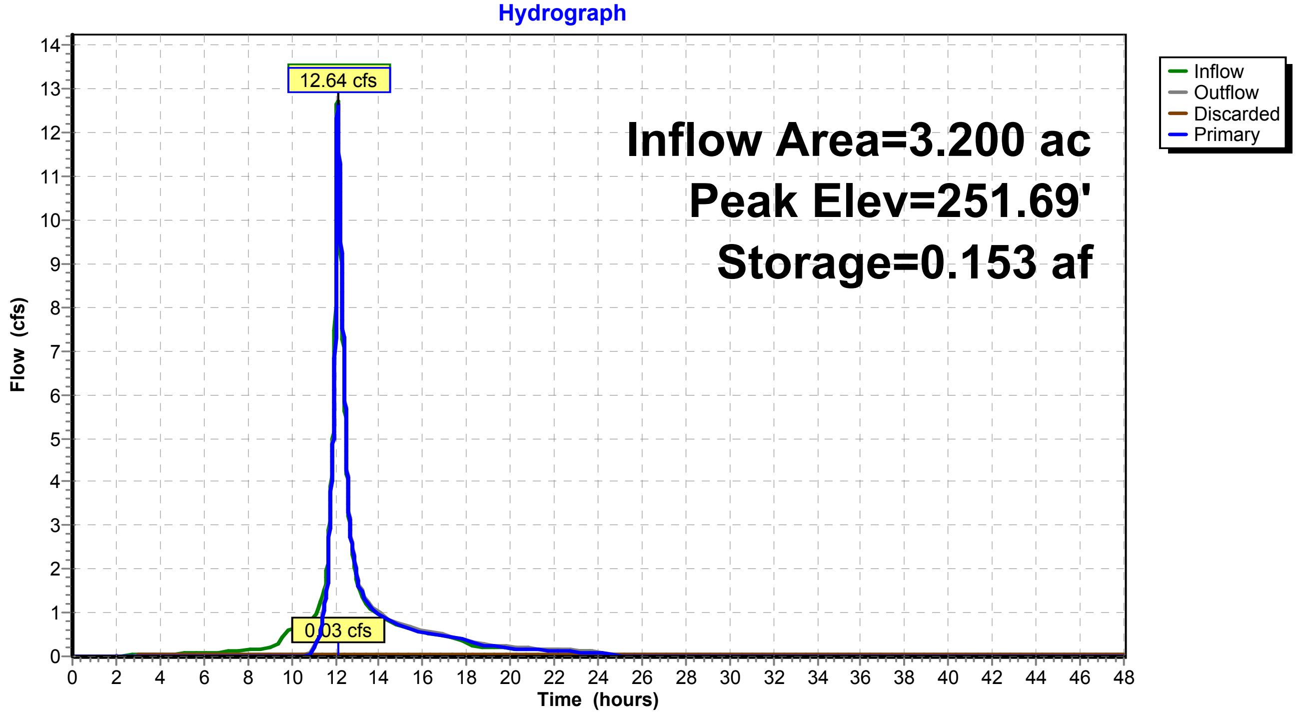
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.00'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	249.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	246.00'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=251.69' (Free Discharge)
└─**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=12.62 cfs @ 12.12 hrs HW=251.69' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 7.30 cfs @ 2.72 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 4.72 cfs @ 4.72 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.60 cfs @ 6.86 fps)

Pond 7P: Galley



Summary for Pond 18P: Rainwater Tank

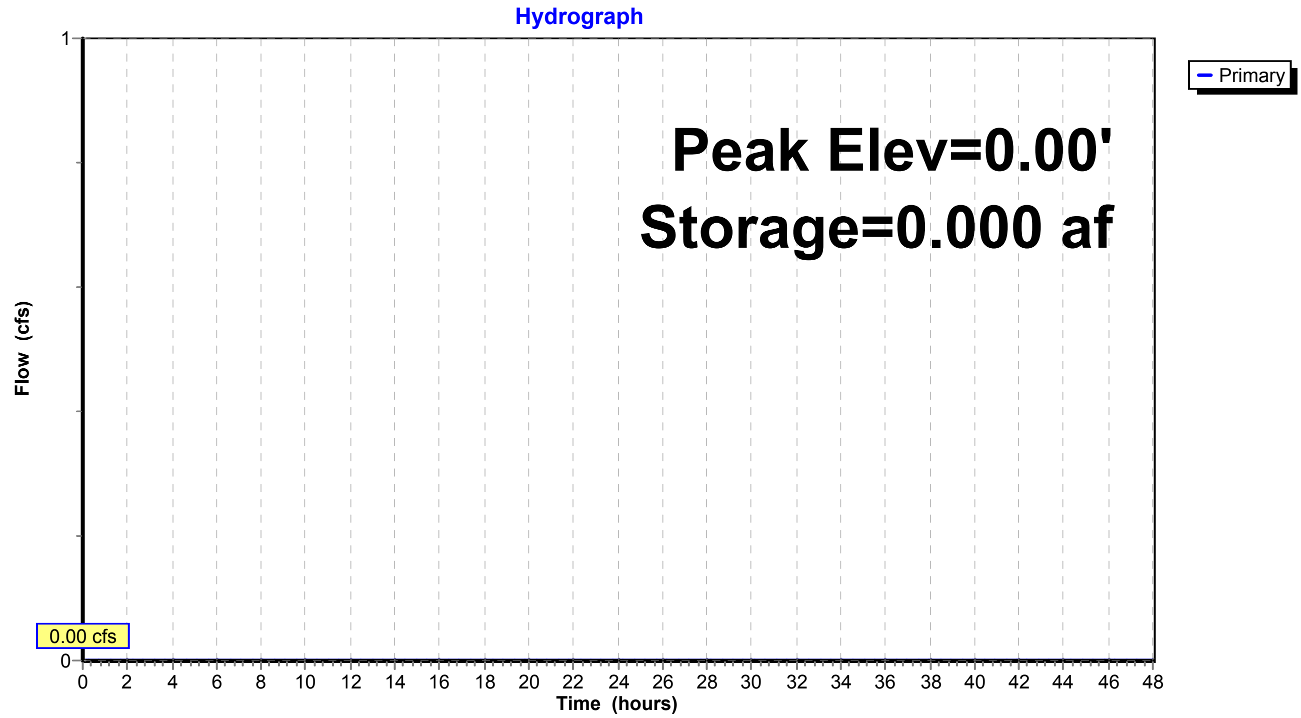
[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	248.50'	0.038 af	**90.0" Round Pipe Storage** L= 37.5'

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)

Pond 18P: Rainwater Tank

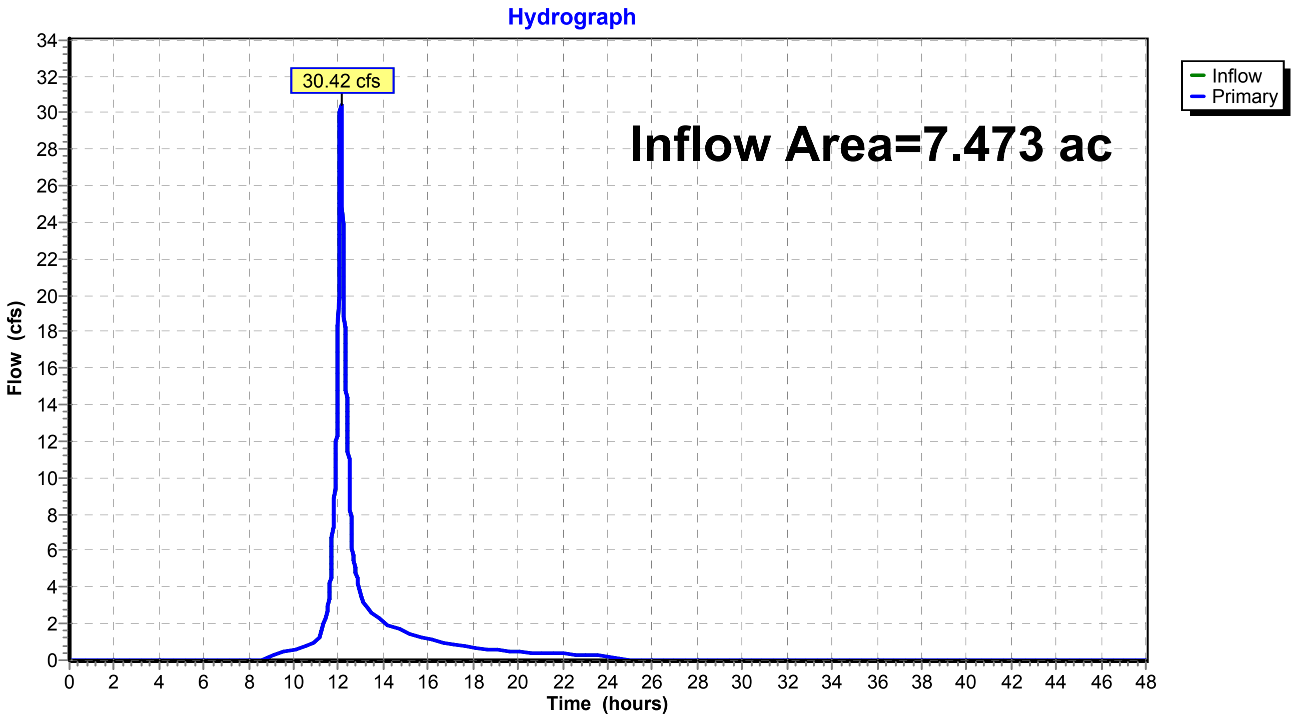


Summary for Link DP1: Reservoir

Inflow Area = 7.473 ac, 67.65% Impervious, Inflow Depth = 3.81" for 25-year event
Inflow = 30.42 cfs @ 12.09 hrs, Volume= 2.374 af
Primary = 30.42 cfs @ 12.09 hrs, Volume= 2.374 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP1: Reservoir

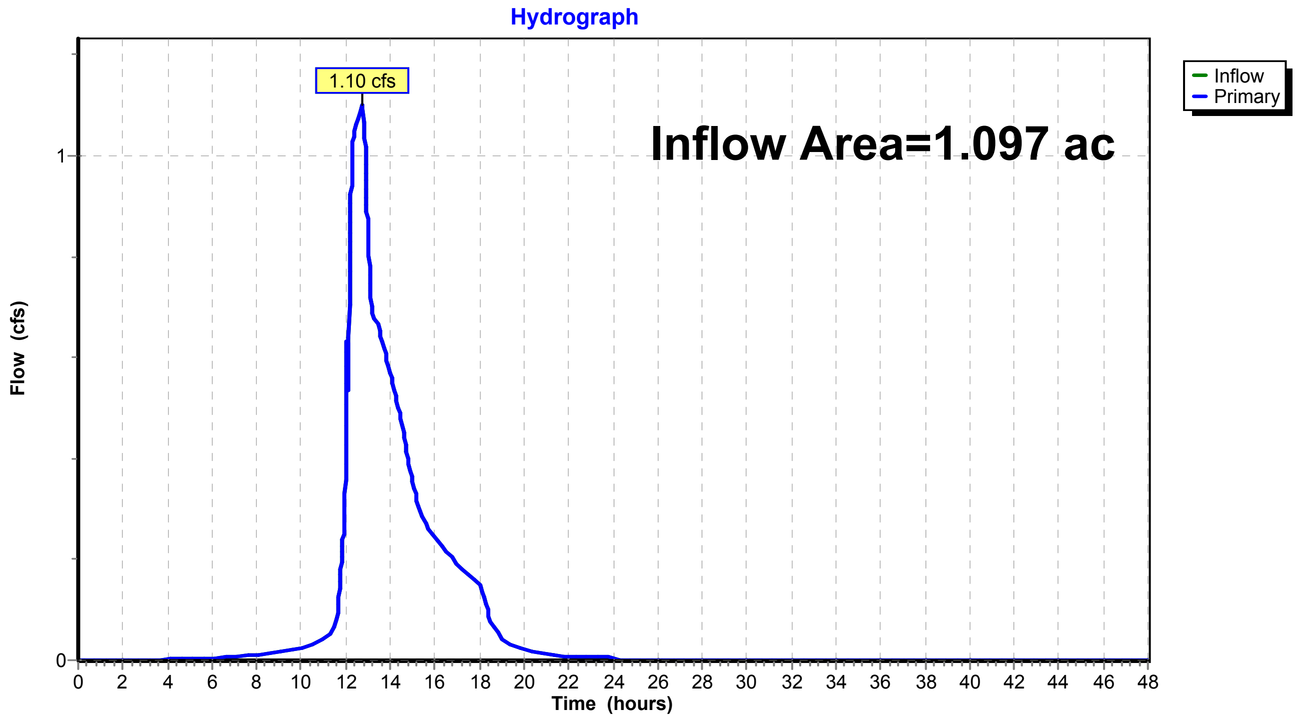


Summary for Link DP2: Penn Avenue

Inflow Area = 1.097 ac, 66.97% Impervious, Inflow Depth = 2.80" for 25-year event
Inflow = 1.10 cfs @ 12.72 hrs, Volume= 0.256 af
Primary = 1.10 cfs @ 12.72 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP2: Penn Avenue

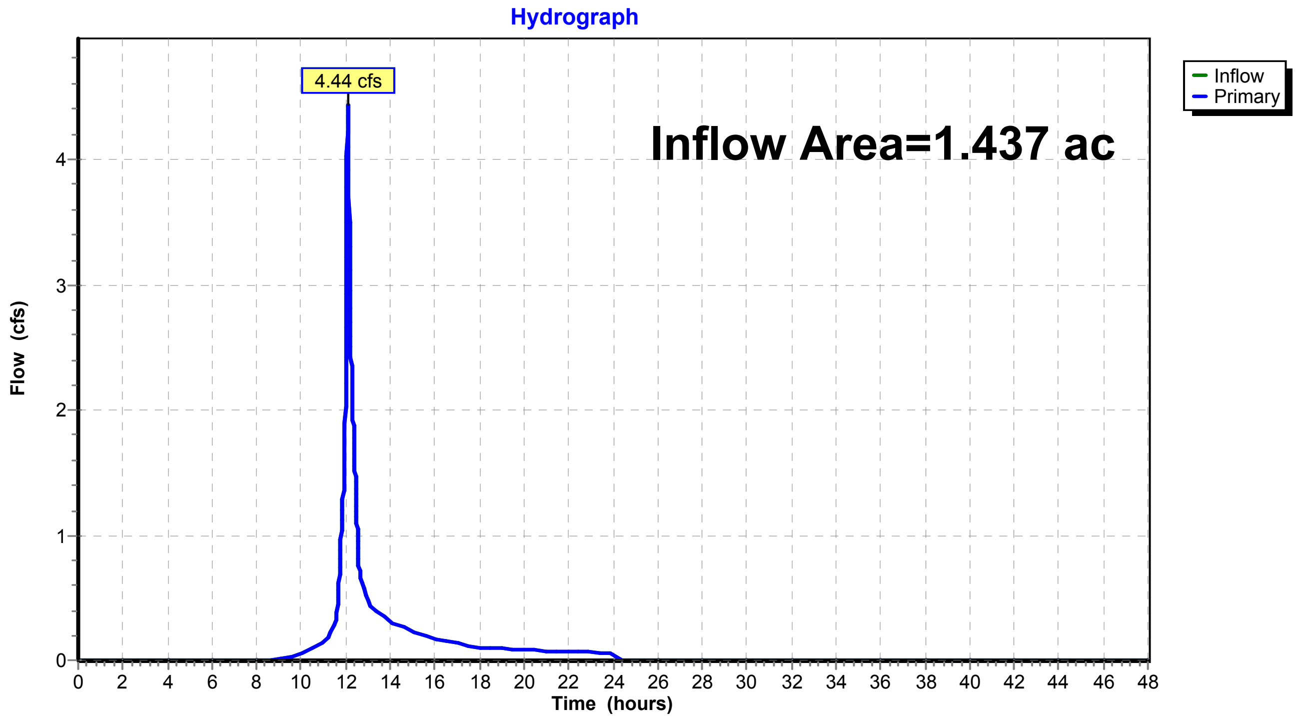


Summary for Link DP3: Swale (Existing)

Inflow Area =	1.437 ac,	0.00% Impervious, Inflow Depth = 2.68"	for 25-year event	
Inflow =	4.44 cfs @	12.10 hrs, Volume=	0.321 af	
Primary =	4.44 cfs @	12.10 hrs, Volume=	0.321 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP3: Swale (Existing)

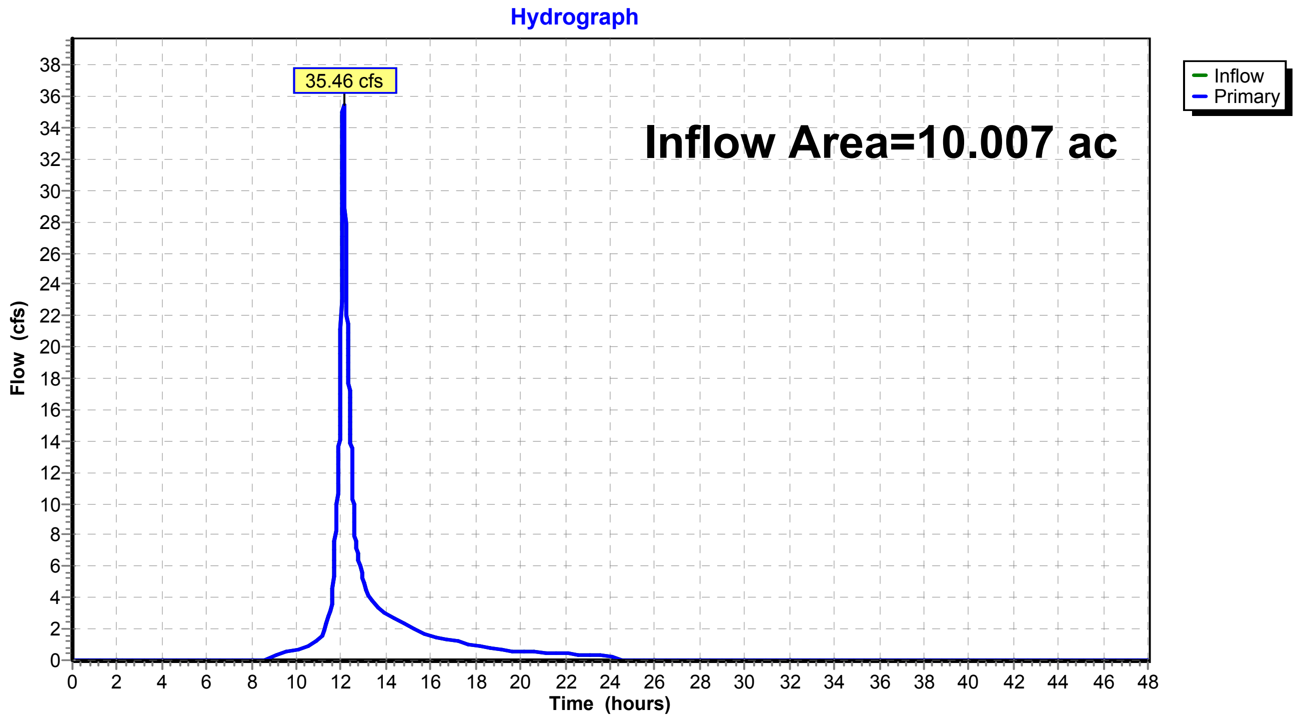


Summary for Link Site: Total Site

Inflow Area = 10.007 ac, 57.86% Impervious, Inflow Depth = 3.54" for 25-year event
Inflow = 35.46 cfs @ 12.09 hrs, Volume= 2.951 af
Primary = 35.46 cfs @ 12.09 hrs, Volume= 2.951 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Site: Total Site

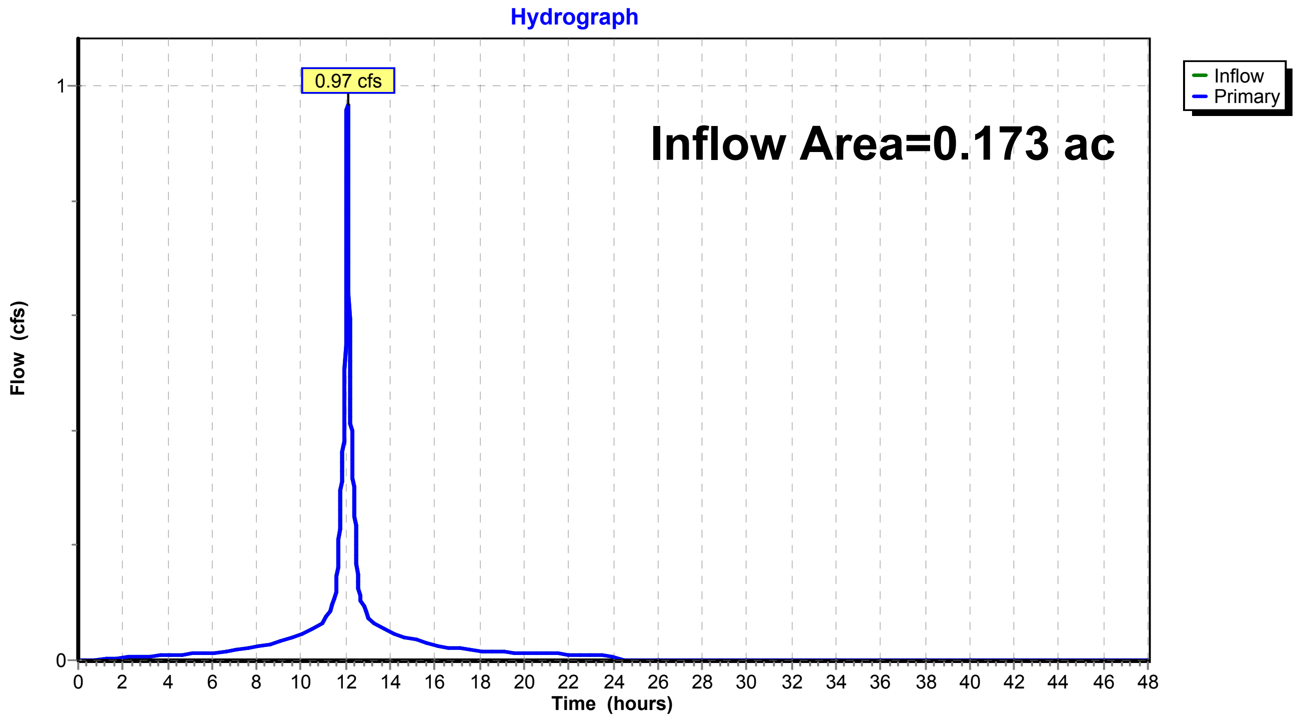


Summary for Link wqu: 450 i

Inflow Area = 0.173 ac,100.00% Impervious, Inflow Depth = 5.26" for 25-year event
Inflow = 0.97 cfs @ 12.07 hrs, Volume= 0.076 af
Primary = 0.97 cfs @ 12.07 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link wqu: 450 i



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Building Runoff Area=55,869 sf 100.00% Impervious Runoff Depth=6.36"
Tc=10.0 min CN=98 Runoff=7.29 cfs 0.680 af

Subcatchment2: Back Lot/LA Runoff Area=31,419 sf 67.58% Impervious Runoff Depth=5.43"
Tc=5.0 min CN=90 Runoff=4.51 cfs 0.326 af

Subcatchment3: Paved Lot/LA Runoff Area=44,557 sf 91.54% Impervious Runoff Depth=6.13"
Tc=5.0 min CN=96 Runoff=6.79 cfs 0.522 af

Subcatchment4: Paved Lot/LA Runoff Area=49,545 sf 68.78% Impervious Runoff Depth=5.55"
Tc=5.0 min CN=91 Runoff=7.20 cfs 0.526 af

Subcatchment5: Paved Lot/LA Runoff Area=65,440 sf 92.74% Impervious Runoff Depth=6.13"
Tc=5.0 min CN=96 Runoff=9.97 cfs 0.767 af

Subcatchment6: LA South Runoff Area=71,141 sf 0.00% Impervious Runoff Depth=3.70"
Flow Length=550' Tc=9.6 min CN=74 Runoff=6.27 cfs 0.503 af

Subcatchment7: Building Runoff Area=27,935 sf 100.00% Impervious Runoff Depth=6.36"
Tc=10.0 min CN=98 Runoff=3.64 cfs 0.340 af

Subcatchment8: LA Area Runoff Area=14,620 sf 0.00% Impervious Runoff Depth=3.70"
Flow Length=50' Slope=0.0100 '/' Tc=7.4 min CN=74 Runoff=1.39 cfs 0.103 af

Subcatchment9: Paved Lot Runoff Area=5,216 sf 77.76% Impervious Runoff Depth=5.78"
Tc=5.0 min CN=93 Runoff=0.78 cfs 0.058 af

Subcatchment10: Wooded Area Runoff Area=62,614 sf 0.00% Impervious Runoff Depth=3.59"
Flow Length=470' Tc=6.4 min CN=73 Runoff=5.97 cfs 0.430 af

Subcatchment11: Paved Lot Runoff Area=7,547 sf 100.00% Impervious Runoff Depth=6.36"
Tc=5.0 min CN=98 Runoff=1.16 cfs 0.092 af

Pond 1P: Surface Detention Peak Elev=255.99' Storage=5,449 cf Inflow=4.99 cfs 0.443 af
Primary=0.81 cfs 0.064 af Secondary=0.98 cfs 0.379 af Outflow=1.79 cfs 0.443 af

Pond 2P: Surface Detention Peak Elev=254.98' Storage=4,899 cf Inflow=11.13 cfs 1.006 af
Primary=6.79 cfs 0.247 af Secondary=2.68 cfs 0.759 af Outflow=9.47 cfs 1.006 af

Pond 4P: Stone Storage Peak Elev=250.99' Storage=3,208 cf Inflow=0.98 cfs 0.379 af
Discarded=0.07 cfs 0.157 af Primary=0.79 cfs 0.223 af Outflow=0.87 cfs 0.379 af

Pond 5P: Galley Peak Elev=229.19' Storage=4,021 cf Inflow=17.17 cfs 1.292 af
Discarded=0.02 cfs 0.076 af Primary=17.09 cfs 1.199 af Outflow=17.11 cfs 1.276 af

Pond 6P: Stone Storage Peak Elev=251.75' Storage=2,477 cf Inflow=2.68 cfs 0.759 af
Discarded=0.05 cfs 0.144 af Primary=2.60 cfs 0.593 af Outflow=2.66 cfs 0.737 af

Pond 7P: Galley Peak Elev=251.85' Storage=0.156 af Inflow=15.58 cfs 1.454 af
Discarded=0.03 cfs 0.127 af Primary=15.48 cfs 1.288 af Outflow=15.52 cfs 1.414 af

Pond 18P: Rainwater Tank Peak Elev=0.00' Storage=0.000 af
Primary=0.00 cfs 0.000 af

Link DP1: Reservoir Inflow=37.69 cfs 2.990 af
Primary=37.69 cfs 2.990 af

Link DP2: Penn Avenue Inflow=1.57 cfs 0.344 af
Primary=1.57 cfs 0.344 af

Link DP3: Swale (Existing) Inflow=5.97 cfs 0.430 af
Primary=5.97 cfs 0.430 af

Link Site: Total Site Inflow=44.92 cfs 3.764 af
Primary=44.92 cfs 3.764 af

Link wqu: 450 i Inflow=1.16 cfs 0.092 af
Primary=1.16 cfs 0.092 af

Total Runoff Area = 10.007 ac Runoff Volume = 4.347 af Average Runoff Depth = 5.21"
42.14% Pervious = 4.217 ac 57.86% Impervious = 5.790 ac

Summary for Subcatchment 1: Building

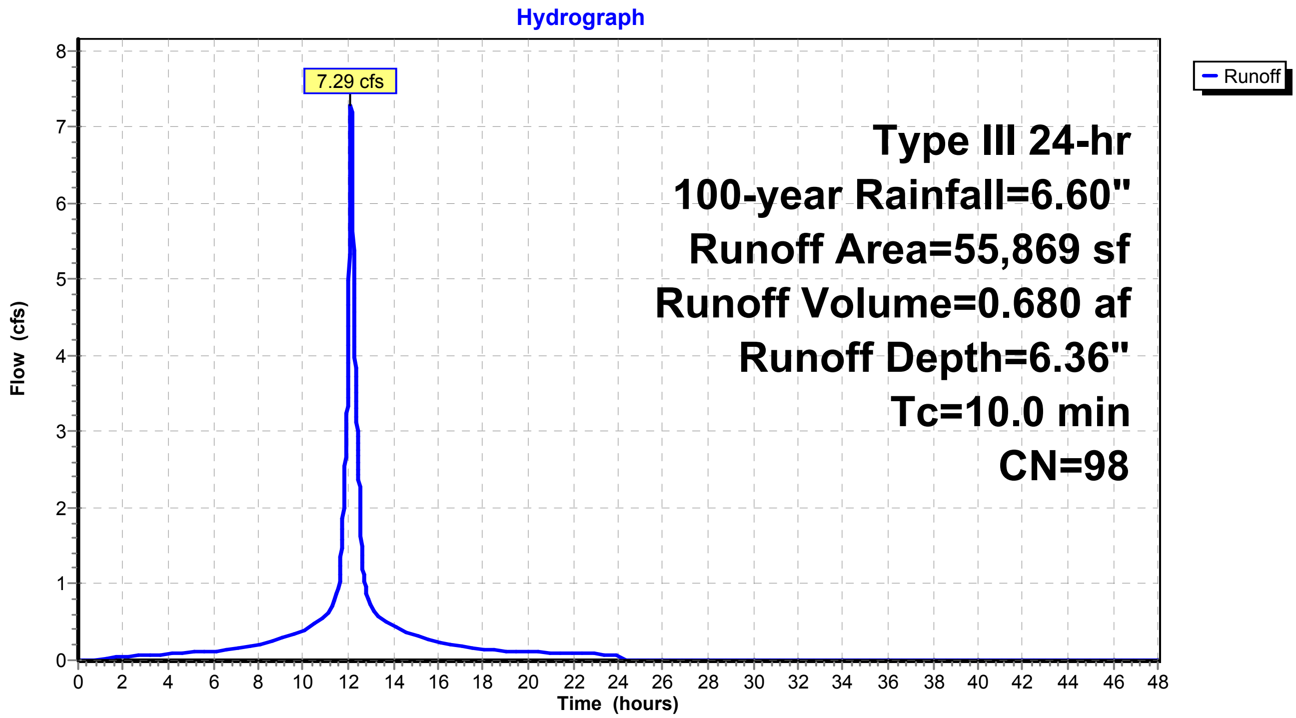
Runoff = 7.29 cfs @ 12.13 hrs, Volume= 0.680 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
55,869	98	Roofs, HSG C
55,869		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1: Building



Summary for Subcatchment 2: Back Lot/LA

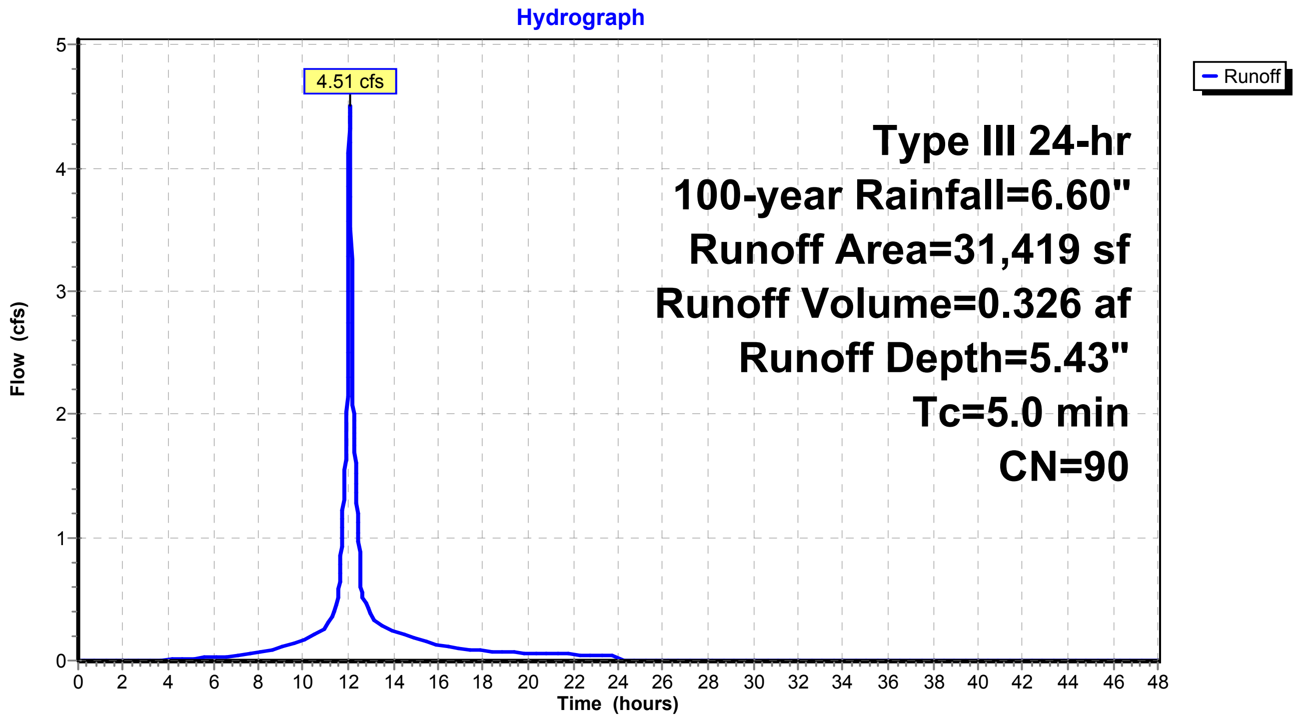
Runoff = 4.51 cfs @ 12.07 hrs, Volume= 0.326 af, Depth= 5.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
21,234	98	Paved parking, HSG C
10,185	74	>75% Grass cover, Good, HSG C
31,419	90	Weighted Average
10,185		32.42% Pervious Area
21,234		67.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Back Lot/LA



Summary for Subcatchment 3: Paved Lot/LA

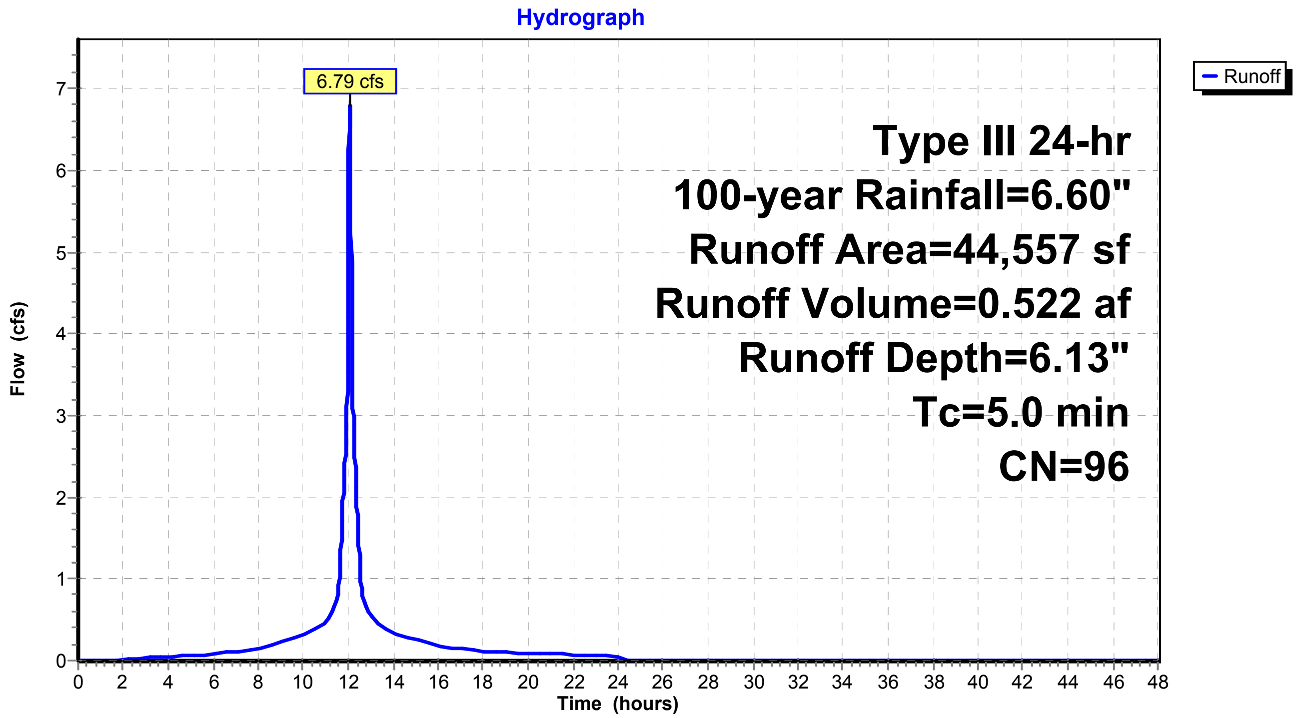
Runoff = 6.79 cfs @ 12.07 hrs, Volume= 0.522 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
40,788	98	Paved parking, HSG C
3,769	74	>75% Grass cover, Good, HSG C
44,557	96	Weighted Average
3,769		8.46% Pervious Area
40,788		91.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Paved Lot/LA



Summary for Subcatchment 4: Paved Lot/LA

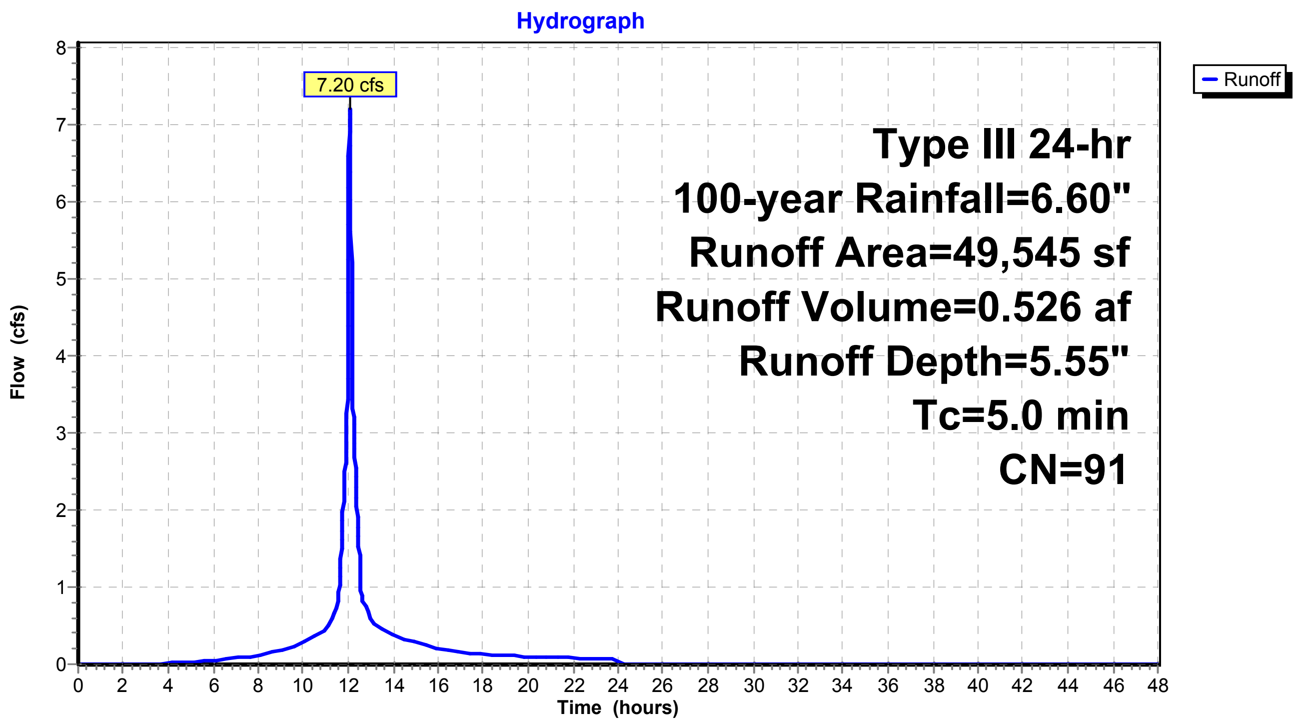
Runoff = 7.20 cfs @ 12.07 hrs, Volume= 0.526 af, Depth= 5.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

	Area (sf)	CN	Description
	34,076	98	Paved parking, HSG C
*	3,279	74	>75% Grass cover, Good, HSG C/Int LA
*	12,190	74	>75% Grass cover, Good, HSG C/LA north
	49,545	91	Weighted Average
	15,469		31.22% Pervious Area
	34,076		68.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Paved Lot/LA



Summary for Subcatchment 5: Paved Lot/LA

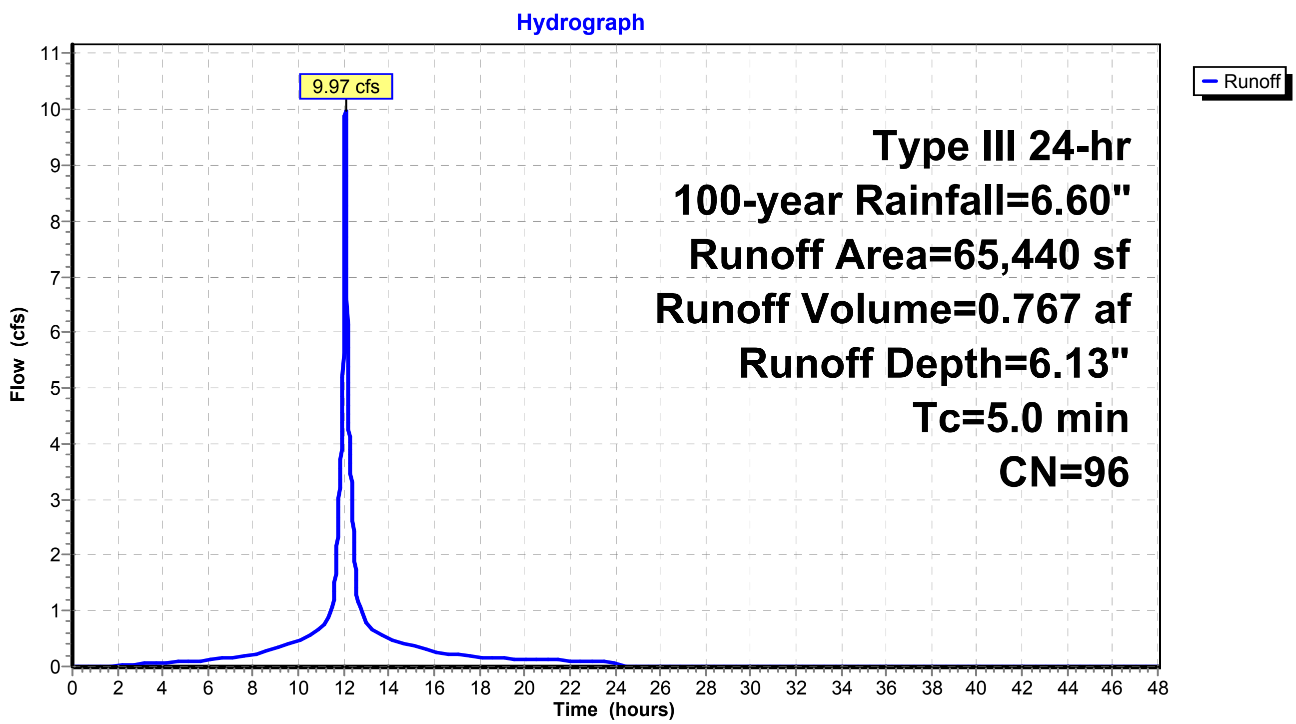
Runoff = 9.97 cfs @ 12.07 hrs, Volume= 0.767 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
60,688	98	Paved parking, HSG C
4,752	74	>75% Grass cover, Good, HSG C
65,440	96	Weighted Average
4,752		7.26% Pervious Area
60,688		92.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Paved Lot/LA



Summary for Subcatchment 6: LA South

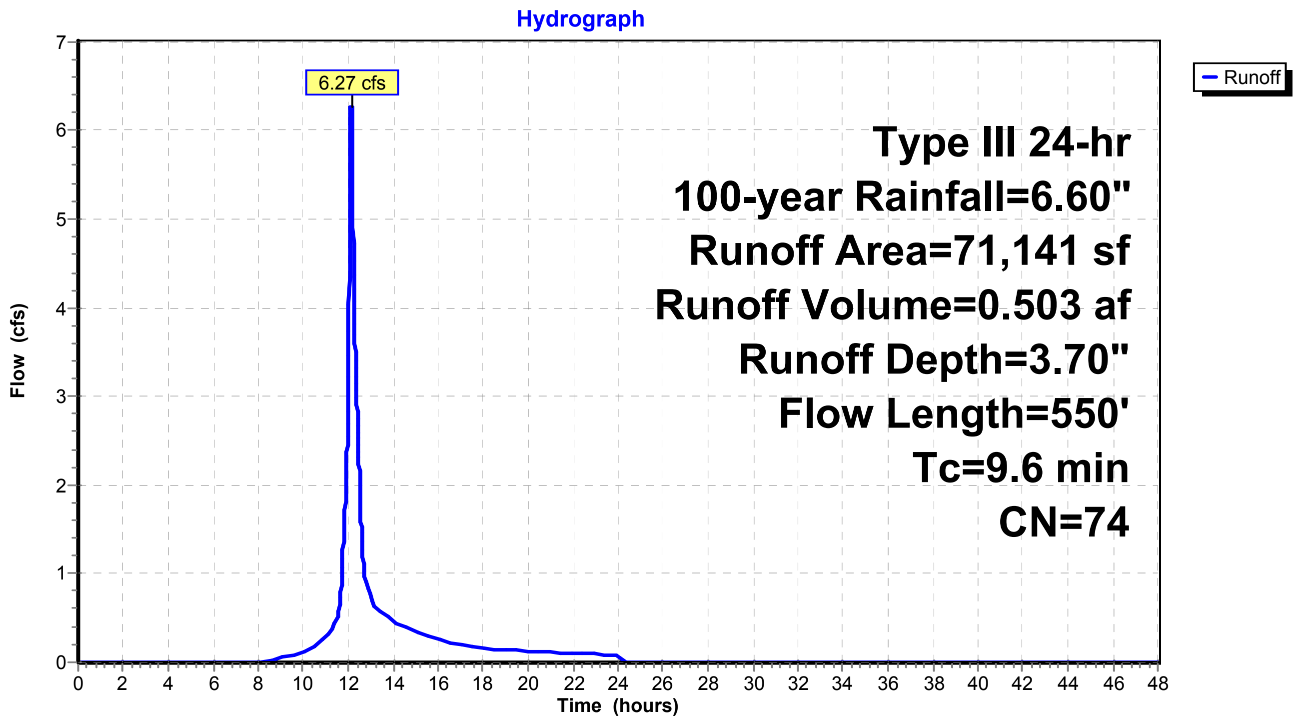
Runoff = 6.27 cfs @ 12.13 hrs, Volume= 0.503 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
71,141	74	>75% Grass cover, Good, HSG C
71,141		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	50	0.1000	0.28		**Sheet Flow, Grass/Wooded Area** Grass: Short n= 0.150 P2= 3.20"
6.0	400	0.0500	1.12		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
0.6	100	0.3000	2.74		**Shallow Concentrated Flow, Grass/Wooded Area** Woodland Kv= 5.0 fps
9.6	550	Total			

Subcatchment 6: LA South



Summary for Subcatchment 7: Building

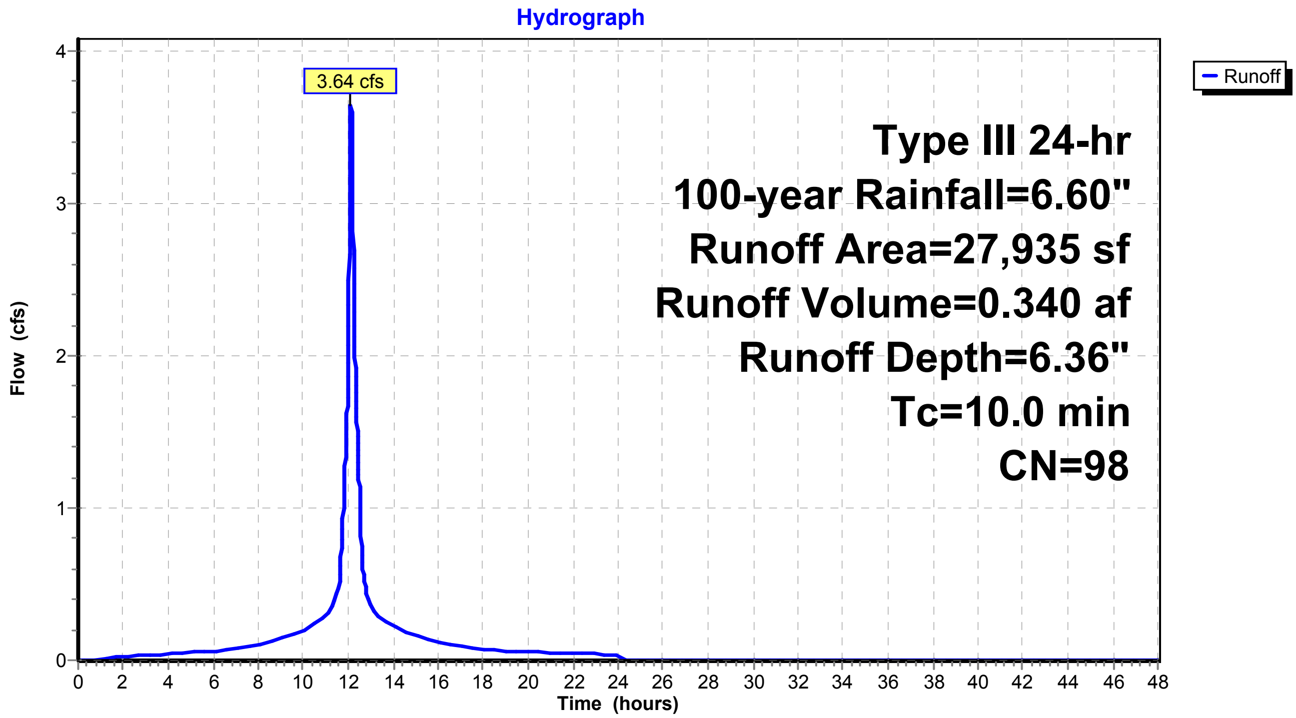
Runoff = 3.64 cfs @ 12.13 hrs, Volume= 0.340 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
27,935	98	Roofs, HSG C
27,935		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 7: Building



Summary for Subcatchment 8: LA Area

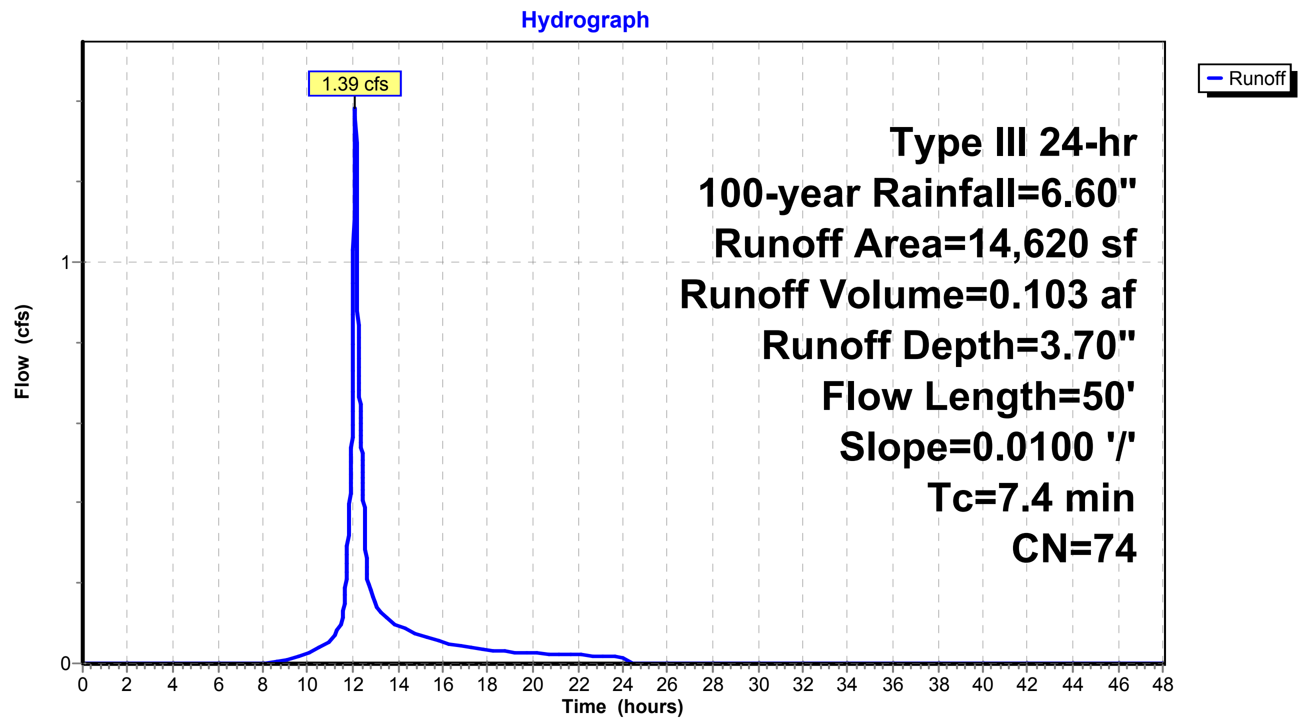
Runoff = 1.39 cfs @ 12.11 hrs, Volume= 0.103 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
14,620	74	>75% Grass cover, Good, HSG C
14,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, Grass Area** Grass: Short n= 0.150 P2= 3.20"

Subcatchment 8: LA Area



Summary for Subcatchment 9: Paved Lot

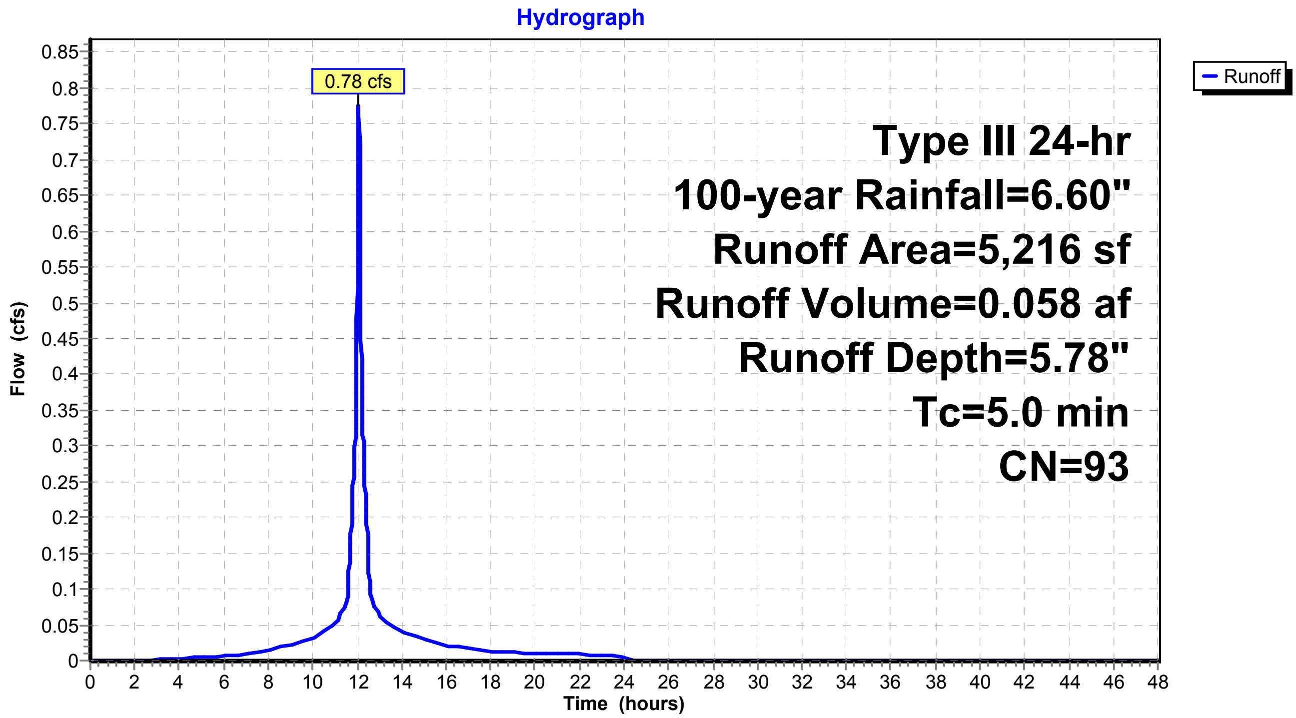
Runoff = 0.78 cfs @ 12.07 hrs, Volume= 0.058 af, Depth= 5.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

	Area (sf)	CN	Description
*	4,056	98	Paved Driveway, HSG C
	1,160	74	>75% Grass cover, Good, HSG C
	5,216	93	Weighted Average
	1,160		22.24% Pervious Area
	4,056		77.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9: Paved Lot



Summary for Subcatchment 10: Wooded Area

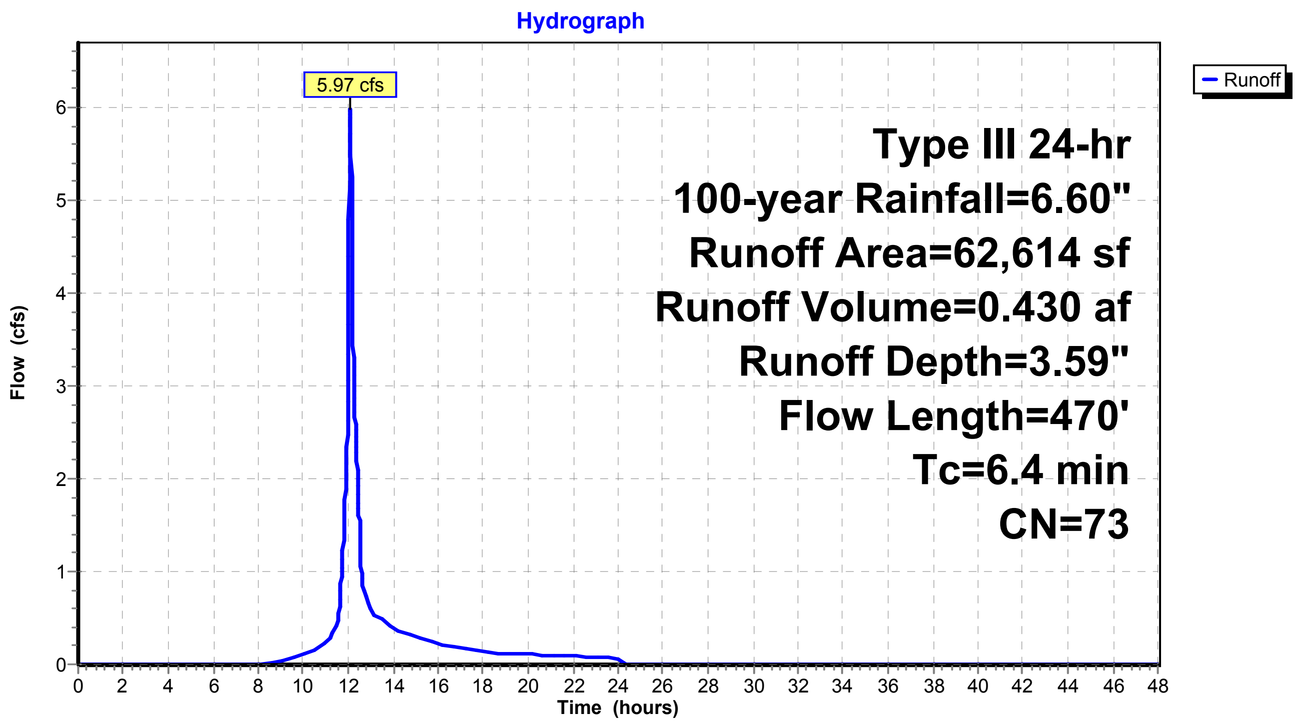
Runoff = 5.97 cfs @ 12.09 hrs, Volume= 0.430 af, Depth= 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
62,614	73	Woods, Fair, HSG C
62,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.3000	0.20		**Sheet Flow, Wooded Area** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	420	0.4000	3.16		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
6.4	470	Total			

Subcatchment 10: Wooded Area



Summary for Subcatchment 11: Paved Lot

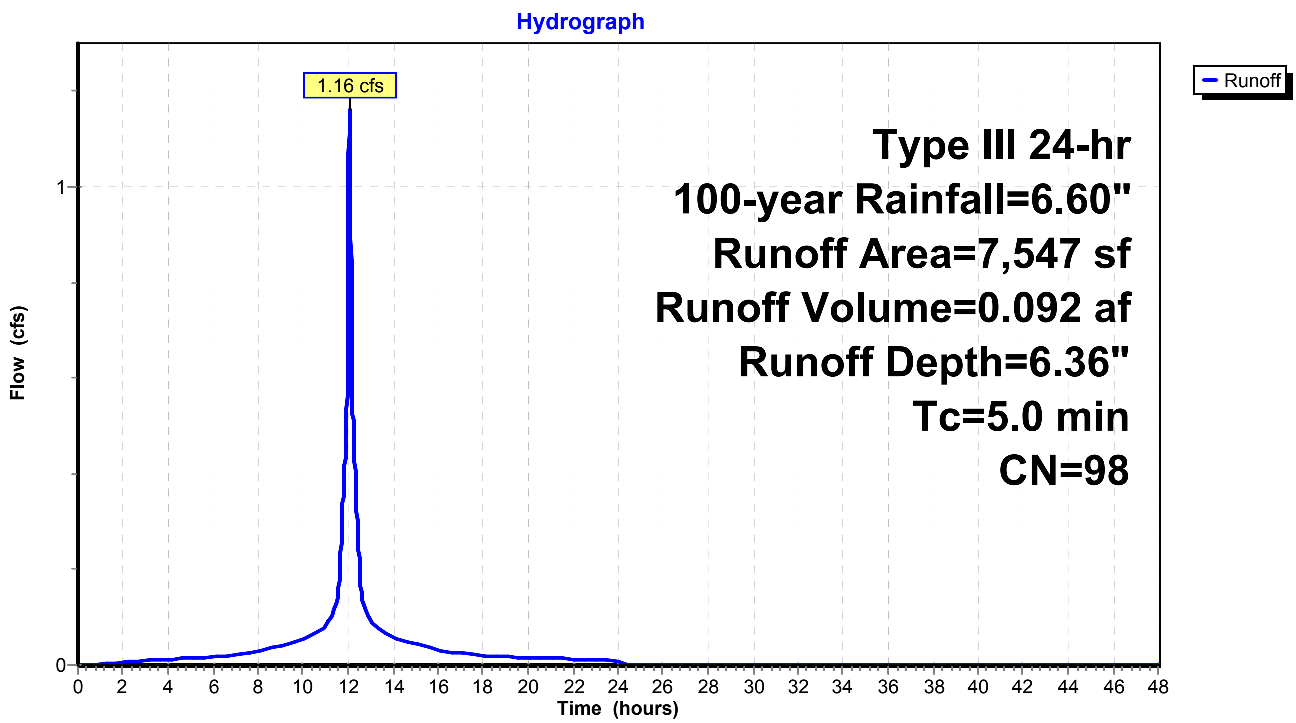
Runoff = 1.16 cfs @ 12.07 hrs, Volume= 0.092 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.60"

Area (sf)	CN	Description
7,547	98	Paved parking, HSG C
7,547		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11: Paved Lot



Summary for Pond 1P: Surface Detention

Inflow Area = 0.977 ac, 65.64% Impervious, Inflow Depth = 5.45" for 100-year event
Inflow = 4.99 cfs @ 12.12 hrs, Volume= 0.443 af
Outflow = 1.79 cfs @ 12.44 hrs, Volume= 0.443 af, Atten= 64%, Lag= 19.2 min
Primary = 0.81 cfs @ 12.44 hrs, Volume= 0.064 af
Secondary = 0.98 cfs @ 12.44 hrs, Volume= 0.379 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 255.99' @ 12.44 hrs Surf.Area= 4,018 sf Storage= 5,449 cf
Flood Elev= 257.00' Surf.Area= 5,368 sf Storage= 10,203 cf

Plug-Flow detention time= 41.9 min calculated for 0.443 af (100% of inflow)
Center-of-Mass det. time= 41.9 min (807.7 - 765.7)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	10,203 cf	**Surface Detention (Irregular)** Listed below (Recalc)

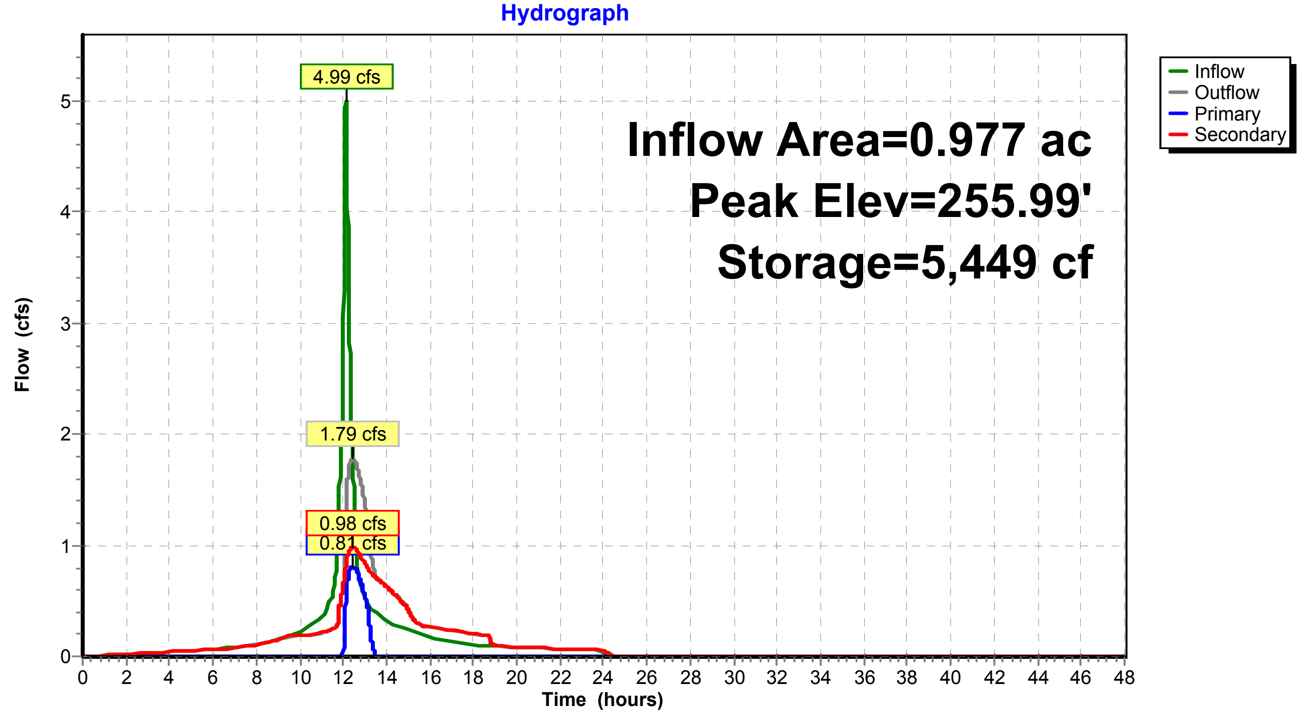
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
254.00	1,548	396.2	0	0	1,548
255.00	2,764	415.0	2,127	2,127	2,828
256.00	4,038	433.9	3,381	5,508	4,173
256.50	4,696	443.3	2,181	7,689	4,865
257.00	5,368	452.7	2,514	10,203	5,572

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	255.25'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	254.60'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	254.00'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=0.81 cfs @ 12.44 hrs HW=255.99' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Orifice/Grate (Orifice Controls 0.81 cfs @ 4.13 fps)

Secondary OutFlow Max=0.98 cfs @ 12.44 hrs HW=255.99' (Free Discharge)
3=Orifice/Grate (Orifice Controls 0.49 cfs @ 5.67 fps)
4=Exfiltration (Exfiltration Controls 0.48 cfs)

Pond 1P: Surface Detention



Summary for Pond 2P: Surface Detention

Inflow Area = 2.004 ac, 88.33% Impervious, Inflow Depth = 6.03" for 100-year event
Inflow = 11.13 cfs @ 12.10 hrs, Volume= 1.006 af
Outflow = 9.47 cfs @ 12.17 hrs, Volume= 1.006 af, Atten= 15%, Lag= 4.0 min
Primary = 6.79 cfs @ 12.17 hrs, Volume= 0.247 af
Secondary = 2.68 cfs @ 12.17 hrs, Volume= 0.759 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 254.98' @ 12.17 hrs Surf.Area= 4,163 sf Storage= 4,899 cf

Plug-Flow detention time= 17.2 min calculated for 1.006 af (100% of inflow)
Center-of-Mass det. time= 17.1 min (775.4 - 758.3)

Volume	Invert	Avail.Storage	Storage Description
#1	253.50'	9,744 cf	**Surface Detention (Irregular)** Listed below (Recalc)

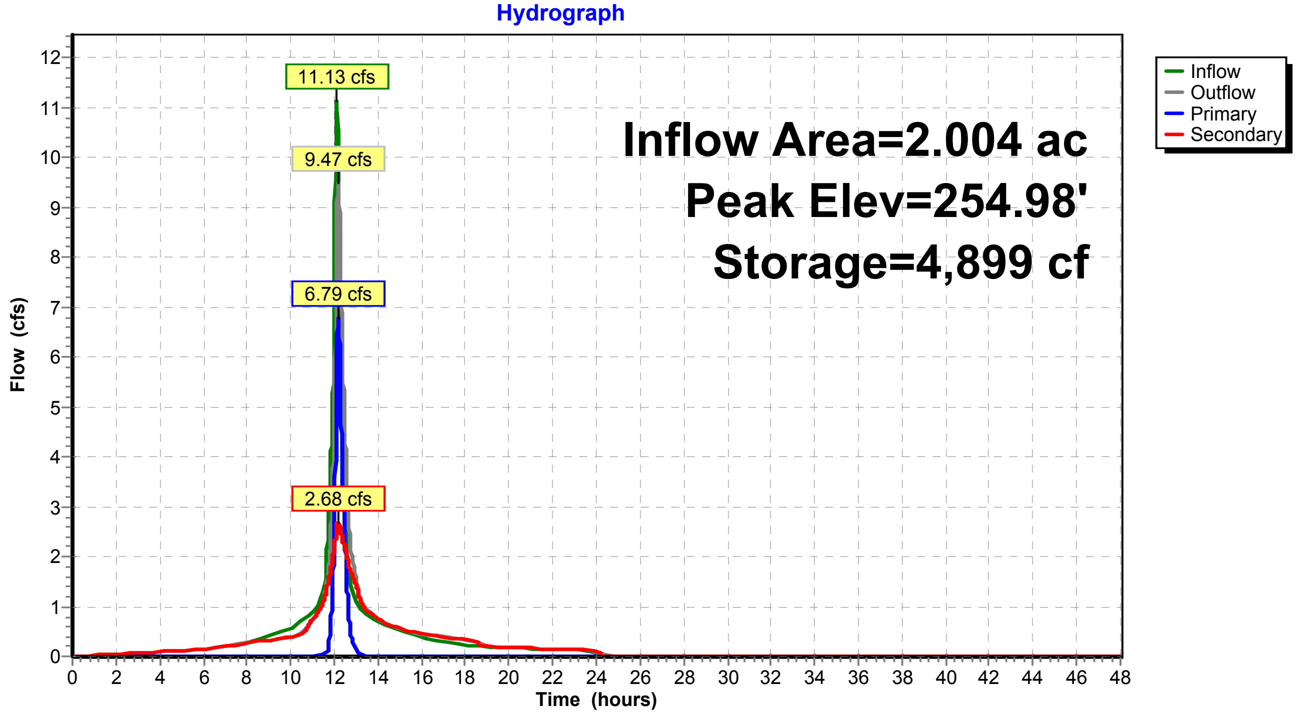
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.50	2,486	280.0	0	0	2,486
254.00	3,039	317.8	1,379	1,379	4,290
255.00	4,186	386.5	3,597	4,976	8,157
256.00	5,374	405.3	4,768	9,744	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	254.33'	**18.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	254.16'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	254.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	253.90'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	253.50'	**5.000 in/hr Exfiltration over Wetted area**

Primary OutFlow Max=6.79 cfs @ 12.17 hrs HW=254.98' (Free Discharge)
├─**1=Orifice/Grate** (Controls 0.00 cfs)
├─**2=Orifice/Grate** (Orifice Controls 2.02 cfs @ 2.75 fps)
├─**3=Orifice/Grate** (Orifice Controls 2.13 cfs @ 3.09 fps)
└─**4=Orifice/Grate** (Orifice Controls 2.64 cfs @ 3.37 fps)

Secondary OutFlow Max=2.68 cfs @ 12.17 hrs HW=254.98' (Free Discharge)
├─**5=Orifice/Grate** (Orifice Controls 1.75 cfs @ 5.01 fps)
└─**6=Exfiltration** (Exfiltration Controls 0.93 cfs)

Pond 2P: Surface Detention



Summary for Pond 4P: Stone Storage

Inflow	=	0.98 cfs @	12.44 hrs, Volume=	0.379 af
Outflow	=	0.87 cfs @	12.89 hrs, Volume=	0.379 af, Atten= 11%, Lag= 26.8 min
Discarded	=	0.07 cfs @	12.89 hrs, Volume=	0.157 af
Primary	=	0.79 cfs @	12.89 hrs, Volume=	0.223 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 250.99' @ 12.89 hrs Surf.Area= 3,771 sf Storage= 3,208 cf

Plug-Flow detention time= 146.0 min calculated for 0.379 af (100% of inflow)
Center-of-Mass det. time= 146.1 min (962.1 - 816.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	250.50'	583 cf	**ADS N-12 12** x 36 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	4,367 cf	**20.84'W x 181.00'L x 3.71'H Field A** 13,987 cf Overall - 754 cf Embedded = 13,233 cf x 33.0% Voids
		4,950 cf	Total Available Storage

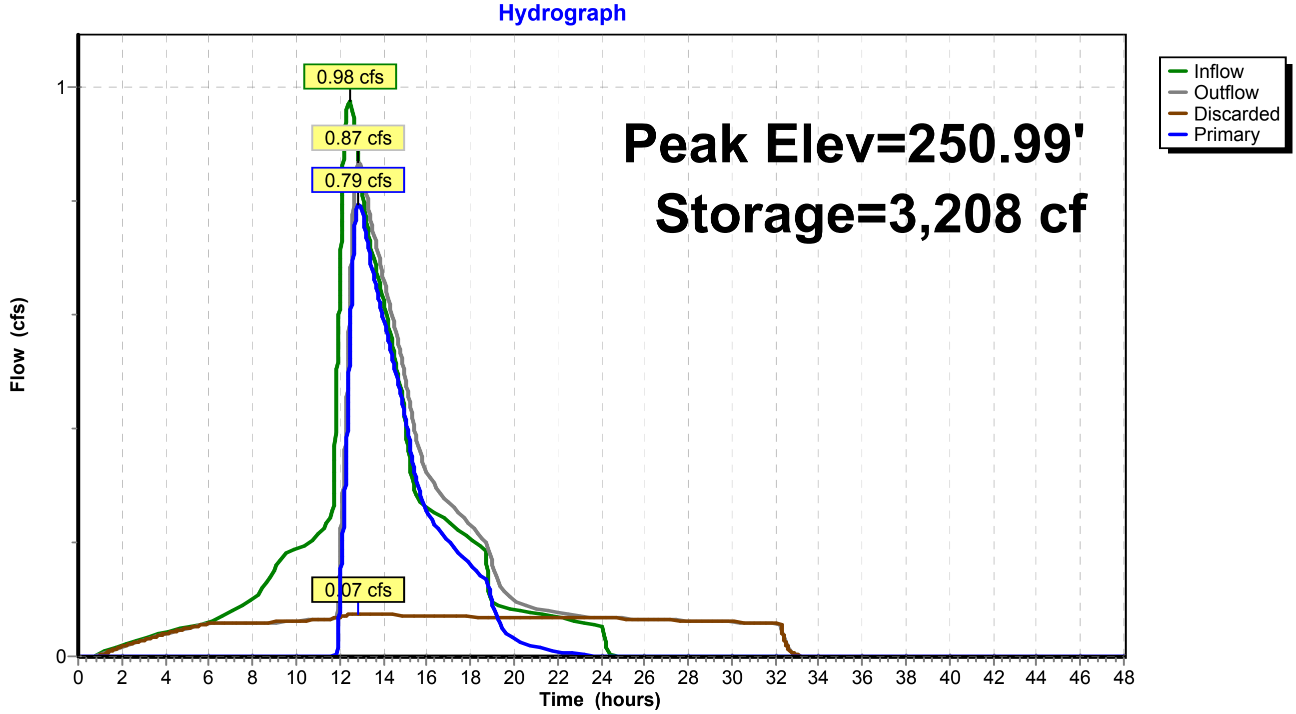
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.50'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	250.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.07 cfs @ 12.89 hrs HW=250.99' (Free Discharge)
└─**4=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.79 cfs @ 12.89 hrs HW=250.99' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
├─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.41 cfs @ 1.74 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.38 cfs @ 4.36 fps)

Pond 4P: Stone Storage



Summary for Pond 5P: Galley

Inflow Area = 2.640 ac, 82.41% Impervious, Inflow Depth = 5.88" for 100-year event
Inflow = 17.17 cfs @ 12.07 hrs, Volume= 1.292 af
Outflow = 17.11 cfs @ 12.08 hrs, Volume= 1.276 af, Atten= 0%, Lag= 0.4 min
Discarded = 0.02 cfs @ 12.08 hrs, Volume= 0.076 af
Primary = 17.09 cfs @ 12.08 hrs, Volume= 1.199 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 229.19' @ 12.08 hrs Surf.Area= 1,300 sf Storage= 4,021 cf

Plug-Flow detention time= 77.3 min calculated for 1.276 af (99% of inflow)
Center-of-Mass det. time= 68.9 min (833.1 - 764.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	224.30'	2,661 cf	**Galley 4x4x4** x 60 Inside #2 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#2A	223.30'	1,623 cf	**26.00'W x 50.00'L x 6.50'H Field A** 8,450 cf Overall - 3,533 cf Embedded = 4,917 cf x 33.0% Voids
		4,283 cf	Total Available Storage

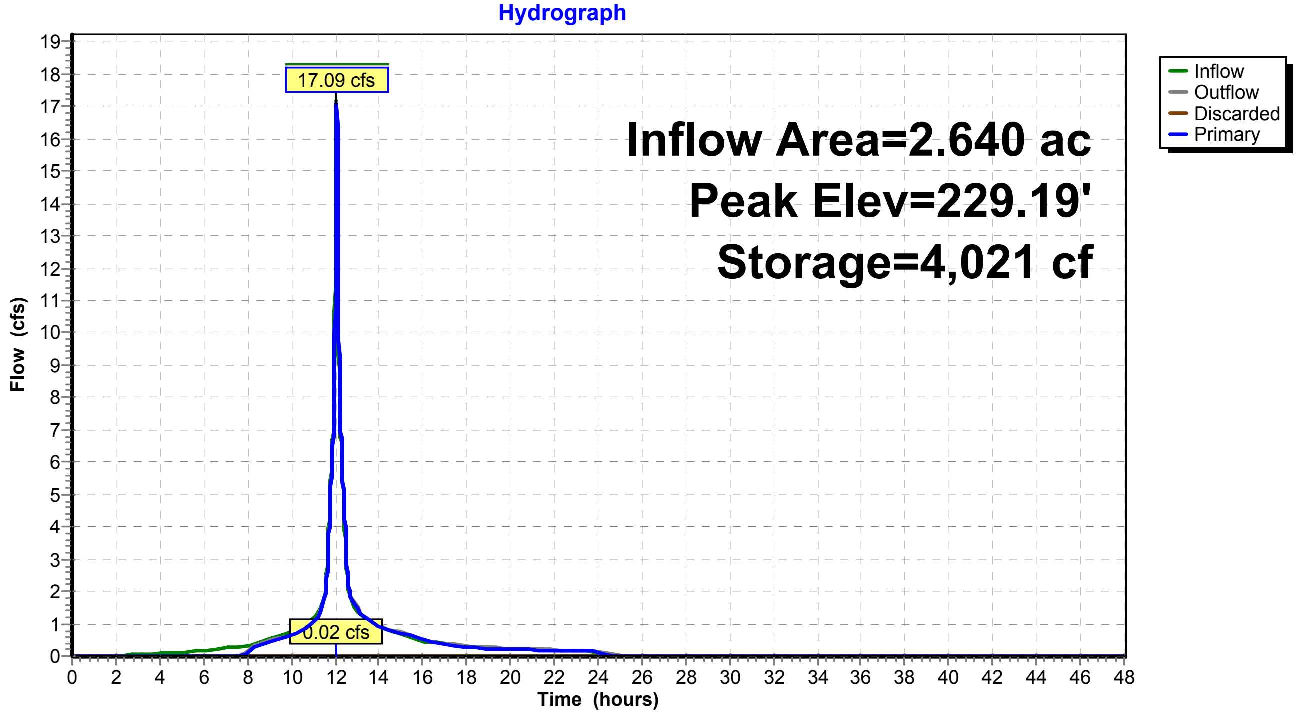
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	228.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	227.30'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	226.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	223.30'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.02 cfs @ 12.08 hrs HW=229.19' (Free Discharge)
└─**4=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=17.06 cfs @ 12.08 hrs HW=229.19' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 10.43 cfs @ 3.08 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 5.15 cfs @ 5.15 fps)
└─**3=Orifice/Grate** (Orifice Controls 1.48 cfs @ 7.52 fps)

Pond 5P: Galley



Summary for Pond 6P: Stone Storage

[93] Warning: Storage range exceeded by 0.54'

Inflow	=	2.68 cfs @	12.17 hrs,	Volume=	0.759 af
Outflow	=	2.66 cfs @	12.17 hrs,	Volume=	0.737 af, Atten= 1%, Lag= 0.0 min
Discarded	=	0.05 cfs @	12.17 hrs,	Volume=	0.144 af
Primary	=	2.60 cfs @	12.17 hrs,	Volume=	0.593 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 251.75' @ 12.17 hrs Surf.Area= 2,521 sf Storage= 2,477 cf

Plug-Flow detention time= 128.9 min calculated for 0.737 af (97% of inflow)
Center-of-Mass det. time= 111.2 min (899.8 - 788.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	249.50'	389 cf	**ADS N-12 12** x 24 Inside #2 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
#2A	248.50'	2,088 cf	**20.84'W x 121.00'L x 2.71'H Field A** 6,829 cf Overall - 502 cf Embedded = 6,327 cf x 33.0% Voids
		2,477 cf	Total Available Storage

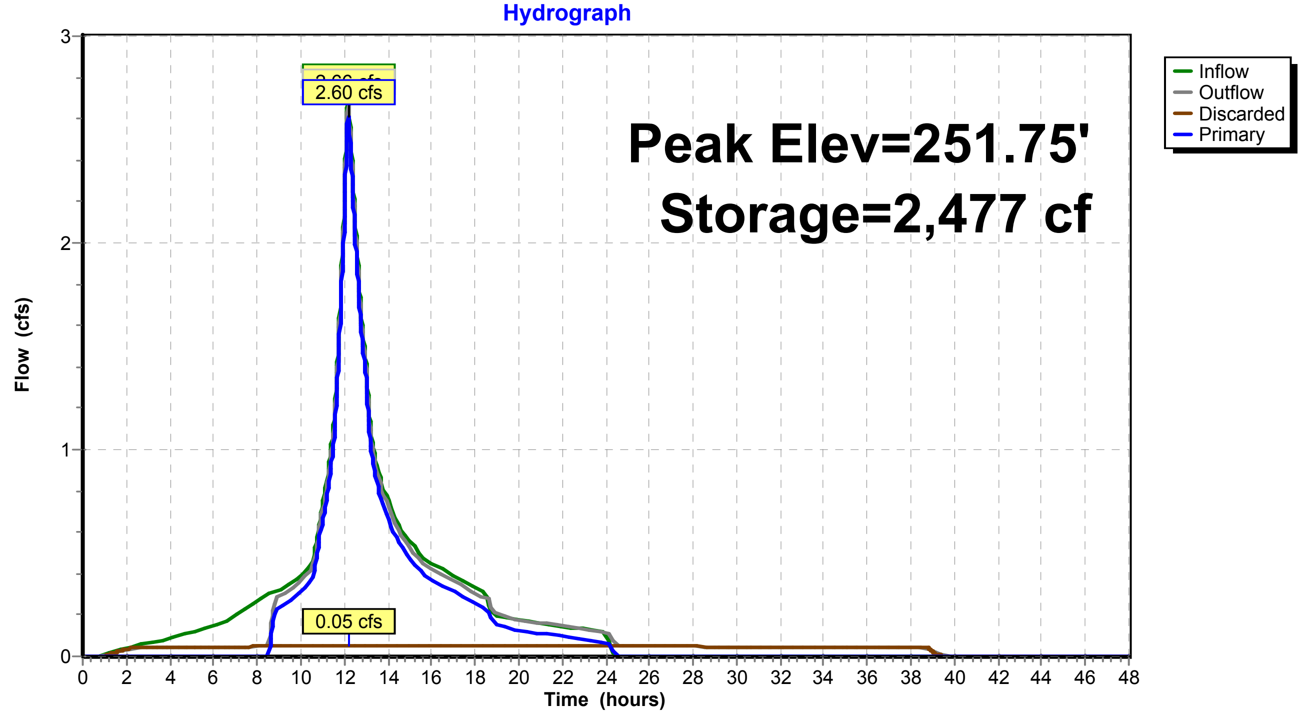
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	248.50'	**0.660 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 12.17 hrs HW=251.75' (Free Discharge)
└─**2=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.60 cfs @ 12.17 hrs HW=251.75' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 2.60 cfs @ 2.95 fps)

Pond 6P: Stone Storage



Summary for Pond 7P: Galley

[81] Warning: Exceeded Pond 6P by 0.11' @ 12.10 hrs

Inflow Area =	3.200 ac,	89.99% Impervious,	Inflow Depth = 5.45"	for 100-year event
Inflow =	15.58 cfs @	12.10 hrs, Volume=	1.454 af	
Outflow =	15.52 cfs @	12.11 hrs, Volume=	1.414 af,	Atten= 0%, Lag= 0.7 min
Discarded =	0.03 cfs @	12.11 hrs, Volume=	0.127 af	
Primary =	15.48 cfs @	12.11 hrs, Volume=	1.288 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 251.85' @ 12.11 hrs Surf.Area= 0.050 ac Storage= 0.156 af

Plug-Flow detention time= 112.7 min calculated for 1.414 af (97% of inflow)
Center-of-Mass det. time= 96.8 min (876.3 - 779.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	247.00'	0.106 af	**Galley 4x4x4.25** x 100 Inside #2 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
#2A	246.00'	0.064 af	**26.50'W x 82.00'L x 6.75'H Field A** 0.337 af Overall - 0.143 af Embedded = 0.194 af x 33.0% Voids
		0.170 af	Total Available Storage

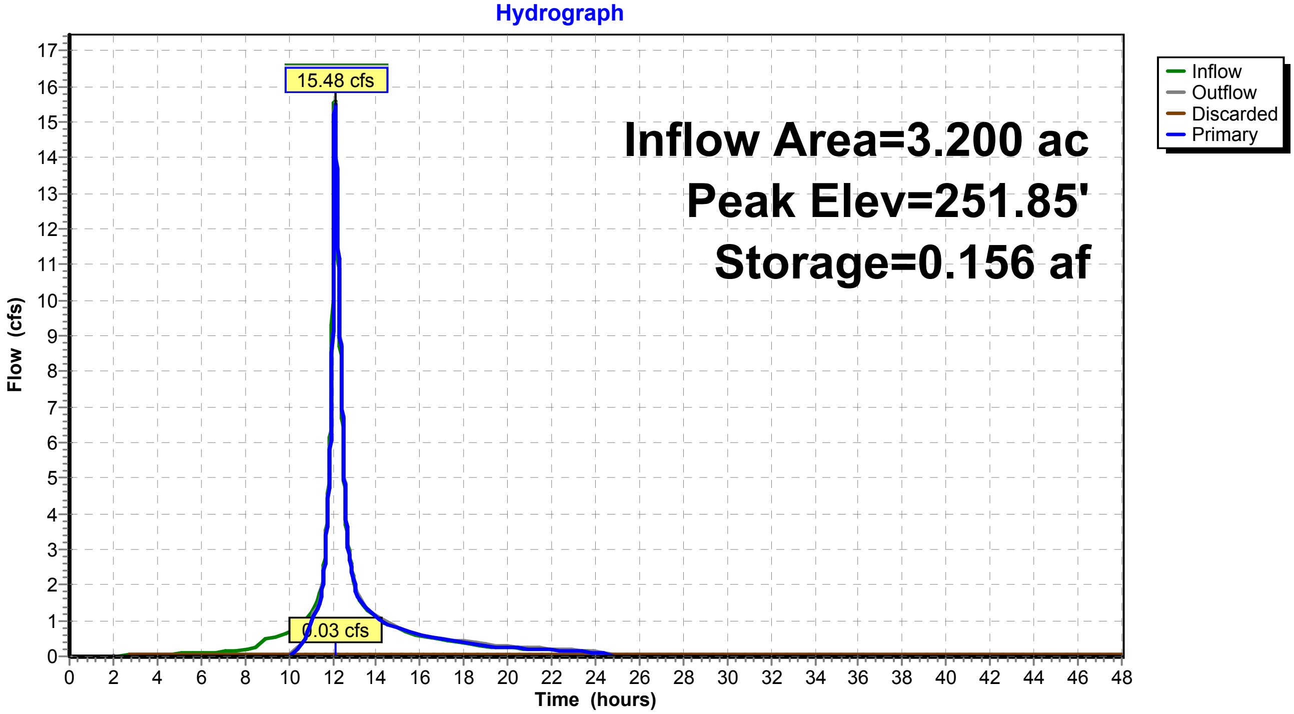
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	251.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	250.00'	**90.0 deg x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.50 (C= 3.13)
#3	Primary	249.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Discarded	246.00'	**0.660 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=251.85' (Free Discharge)
└─**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=15.47 cfs @ 12.11 hrs HW=251.85' (Free Discharge)
├─**1=Sharp-Crested Rectangular Weir** (Weir Controls 9.78 cfs @ 3.01 fps)
├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 5.07 cfs @ 5.07 fps)
└─**3=Orifice/Grate** (Orifice Controls 0.62 cfs @ 7.11 fps)

Pond 7P: Galley



Summary for Pond 18P: Rainwater Tank

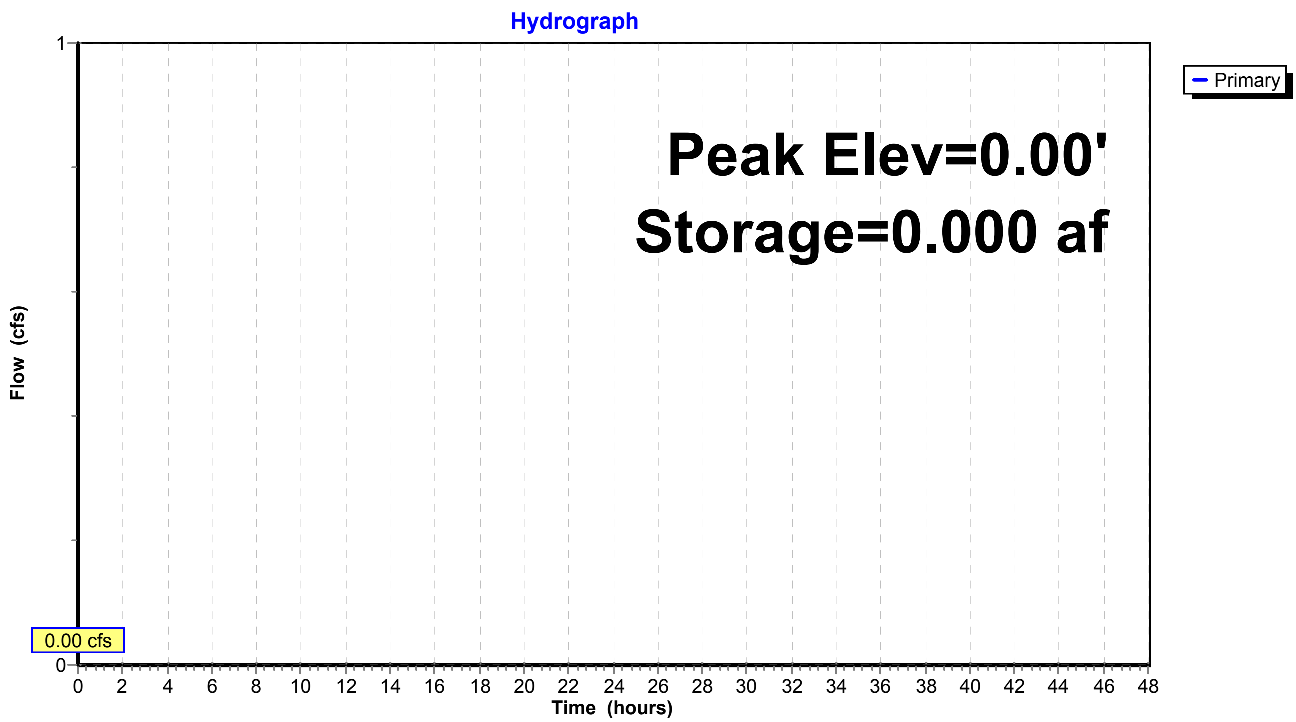
[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	248.50'	0.038 af	**90.0" Round Pipe Storage** L= 37.5'

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Orifice/Grate** (Controls 0.00 cfs)

Pond 18P: Rainwater Tank

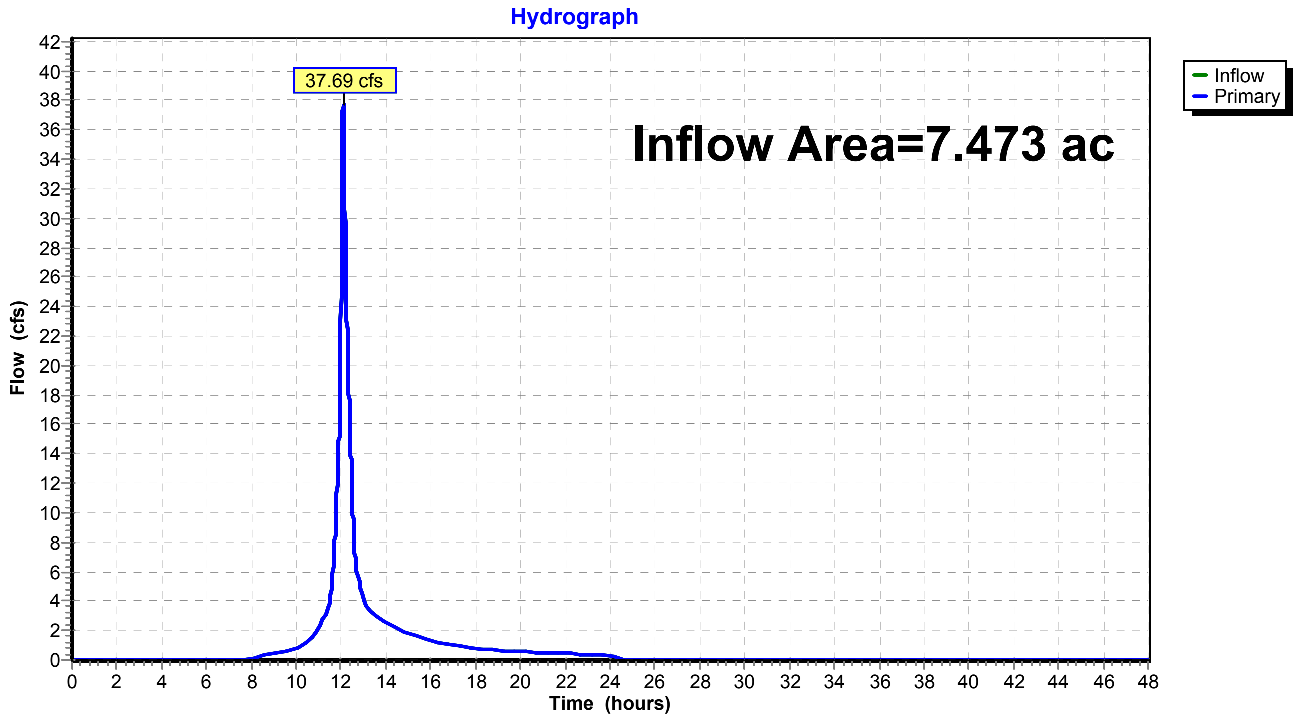


Summary for Link DP1: Reservoir

Inflow Area = 7.473 ac, 67.65% Impervious, Inflow Depth = 4.80" for 100-year event
Inflow = 37.69 cfs @ 12.09 hrs, Volume= 2.990 af
Primary = 37.69 cfs @ 12.09 hrs, Volume= 2.990 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP1: Reservoir

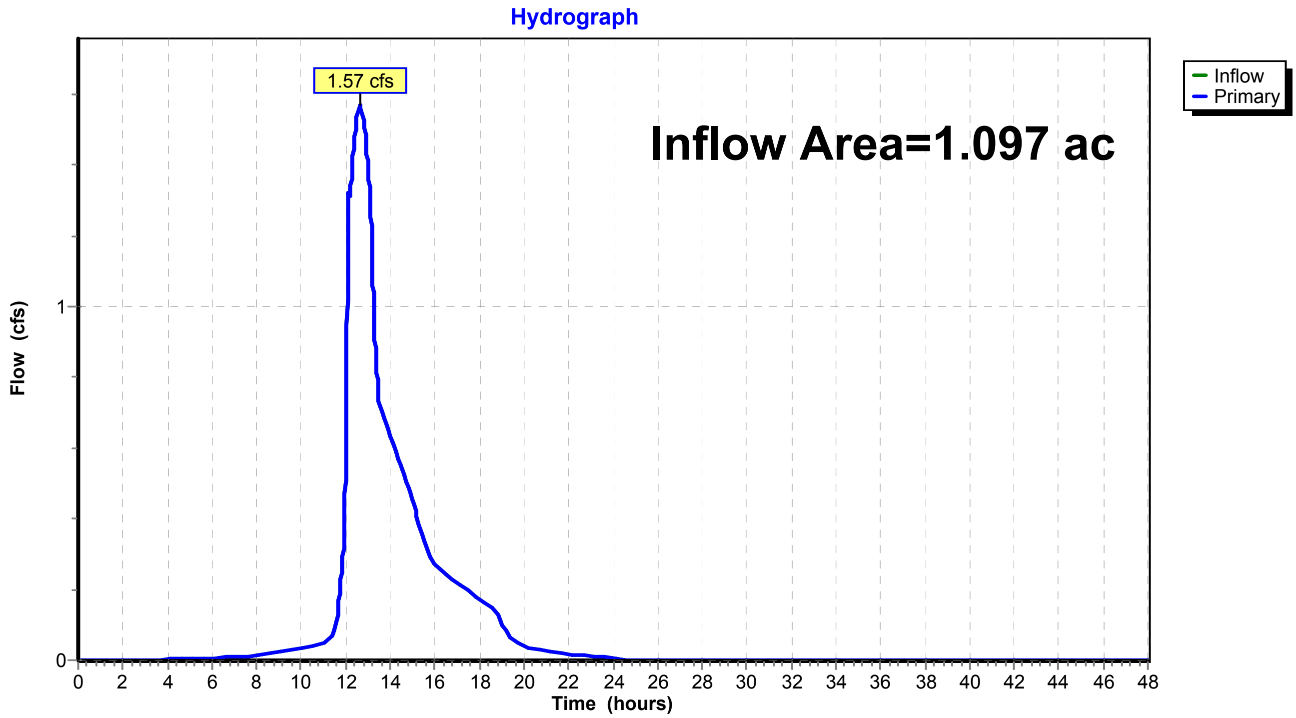


Summary for Link DP2: Penn Avenue

Inflow Area =	1.097 ac,	66.97% Impervious,	Inflow Depth = 3.77"	for 100-year event
Inflow =	1.57 cfs @	12.67 hrs, Volume=	0.344 af	
Primary =	1.57 cfs @	12.67 hrs, Volume=	0.344 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP2: Penn Avenue

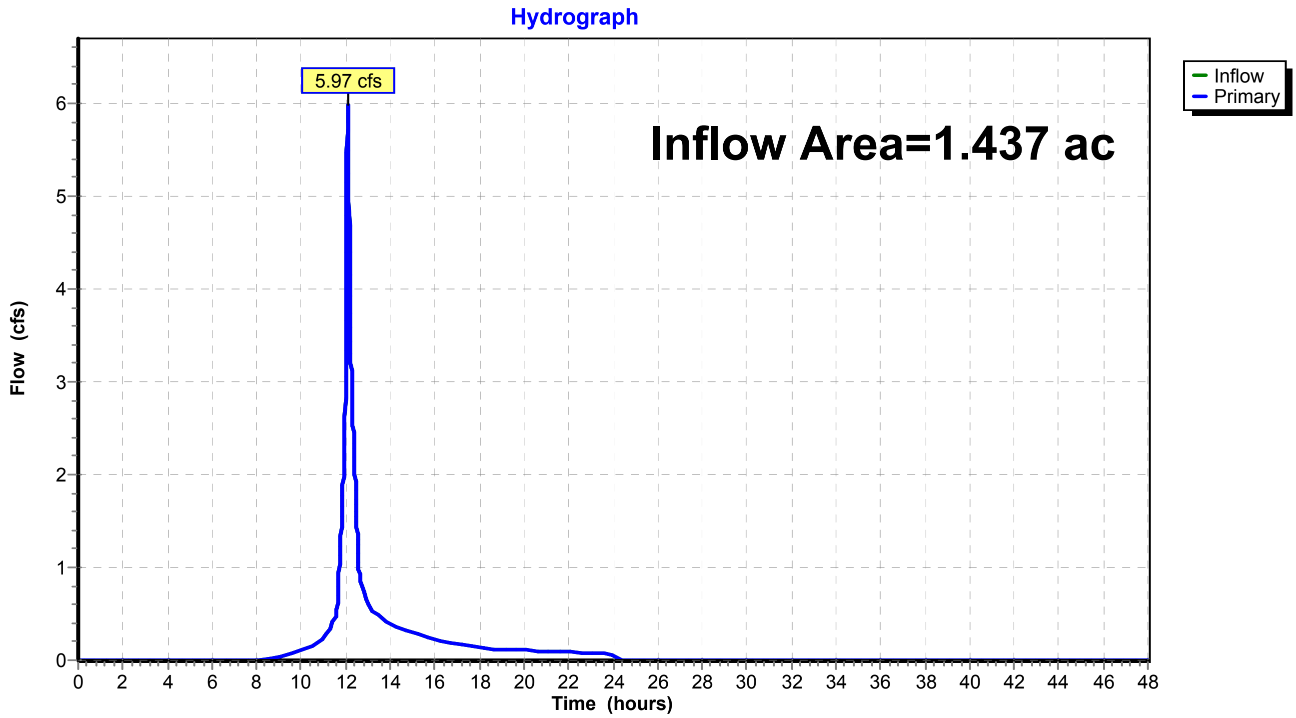


Summary for Link DP3: Swale (Existing)

Inflow Area =	1.437 ac,	0.00% Impervious,	Inflow Depth = 3.59"	for 100-year event
Inflow =	5.97 cfs @	12.09 hrs, Volume=	0.430 af	
Primary =	5.97 cfs @	12.09 hrs, Volume=	0.430 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link DP3: Swale (Existing)

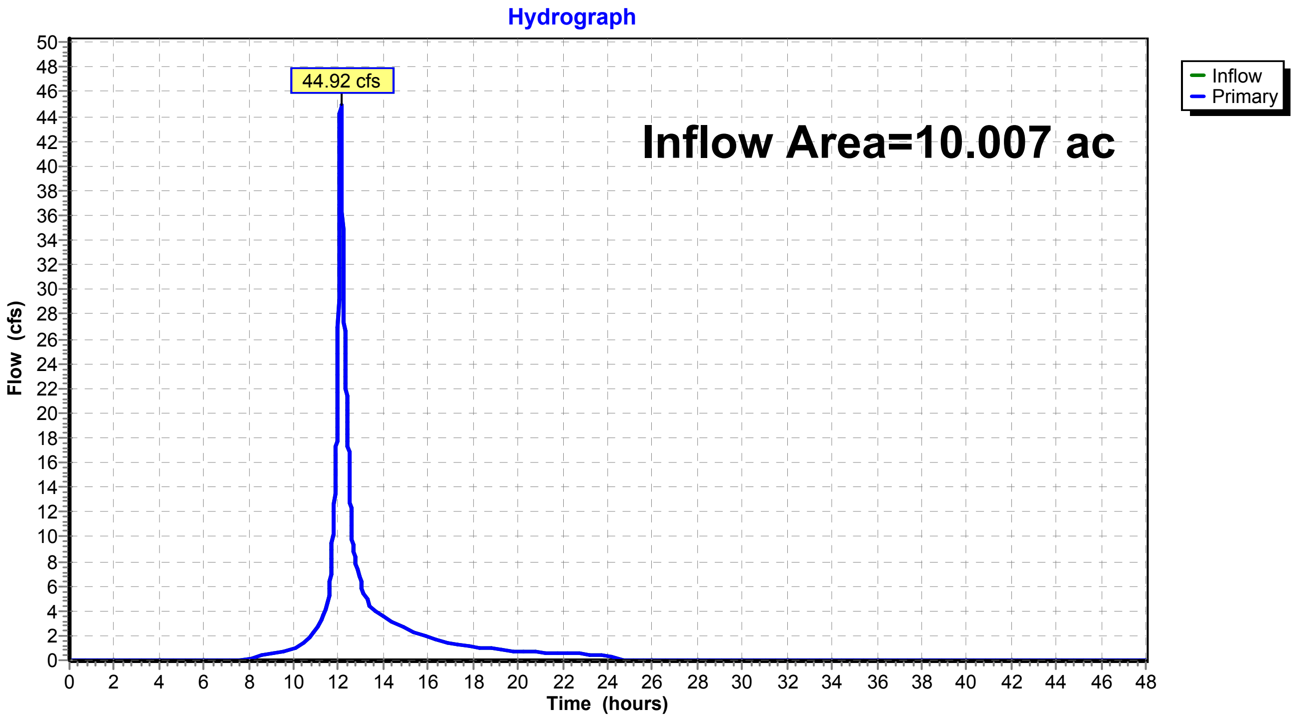


Summary for Link Site: Total Site

Inflow Area =	10.007 ac, 57.86% Impervious, Inflow Depth = 4.51" for 100-year event			
Inflow =	44.92 cfs @	12.10 hrs, Volume=	3.764 af	
Primary =	44.92 cfs @	12.10 hrs, Volume=	3.764 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

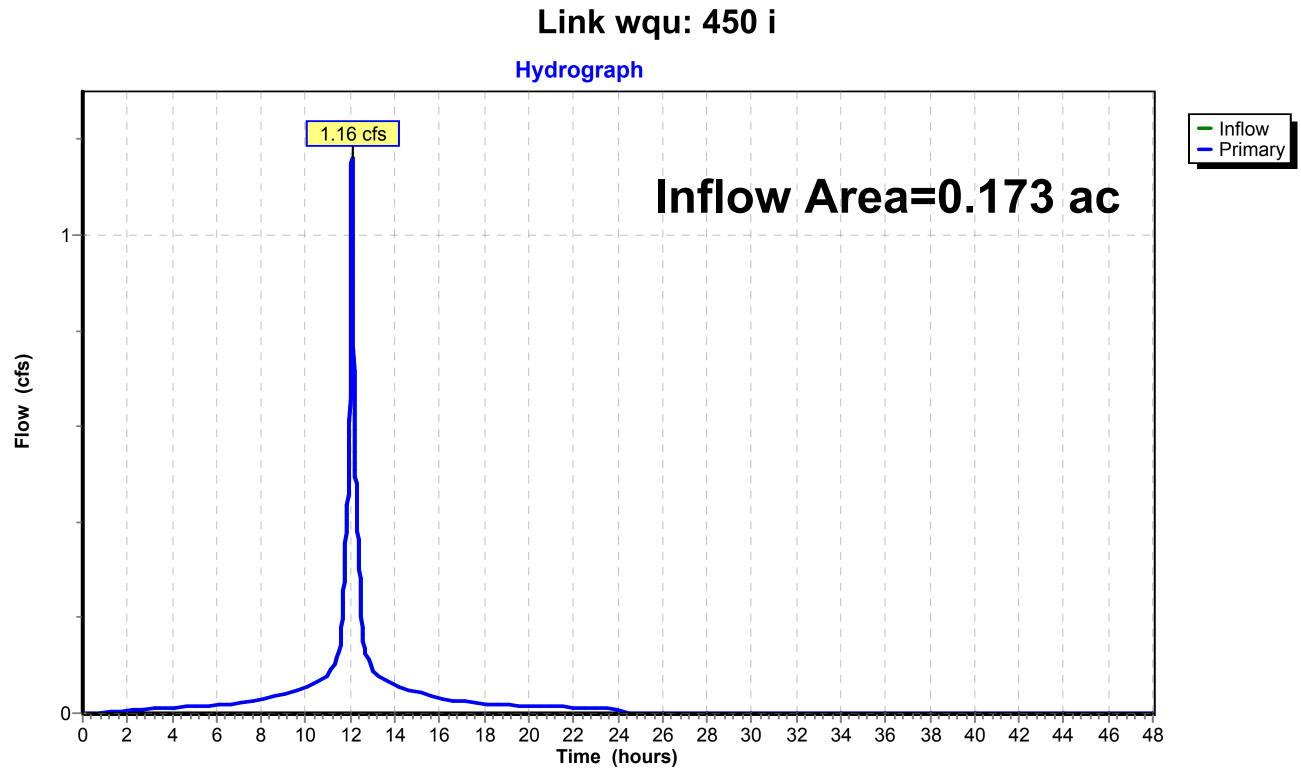
Link Site: Total Site



Summary for Link wqu: 450 i

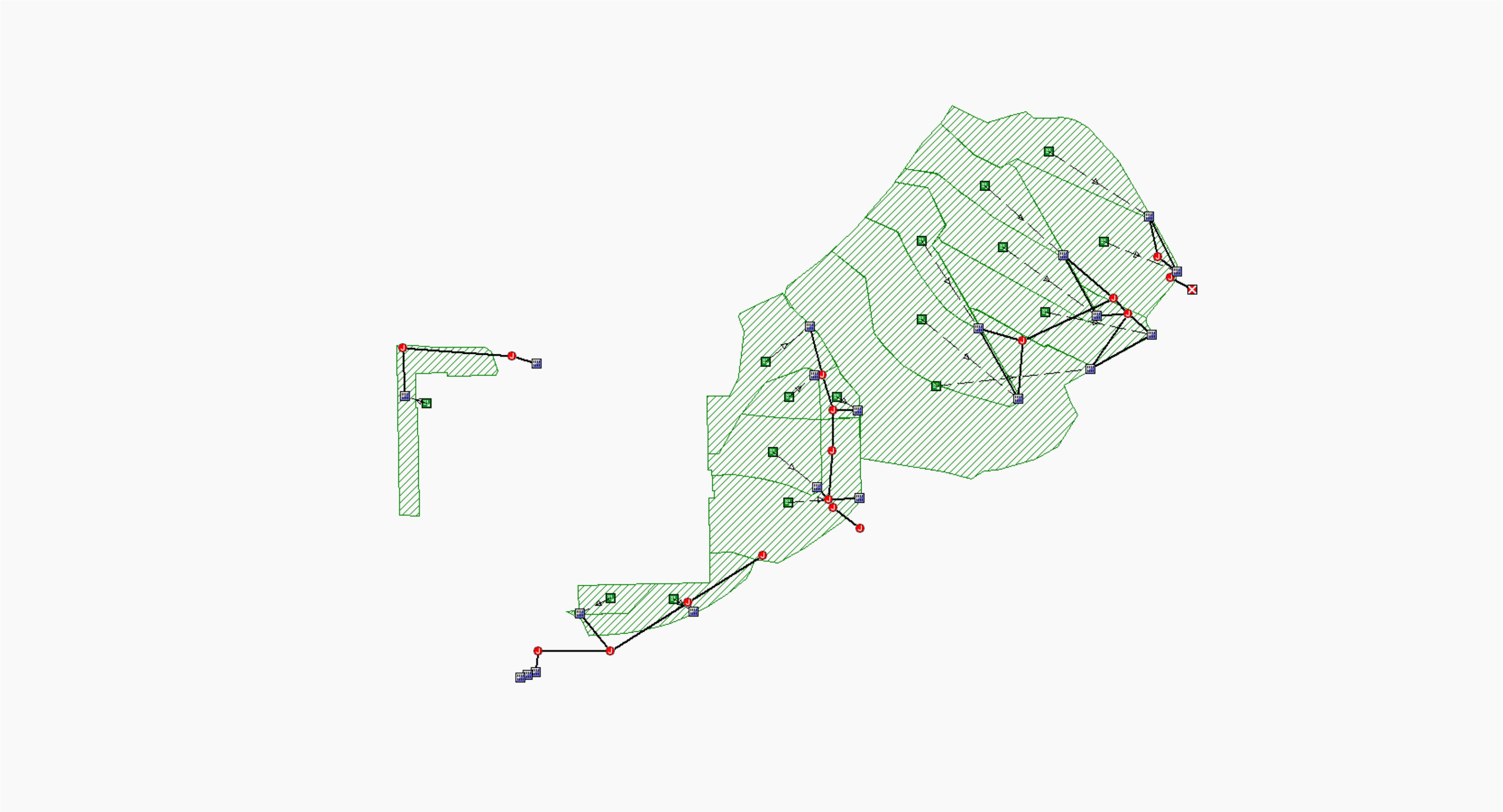
Inflow Area = 0.173 ac,100.00% Impervious, Inflow Depth = 6.36" for 100-year event
Inflow = 1.16 cfs @ 12.07 hrs, Volume= 0.092 af
Primary = 1.16 cfs @ 12.07 hrs, Volume= 0.092 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



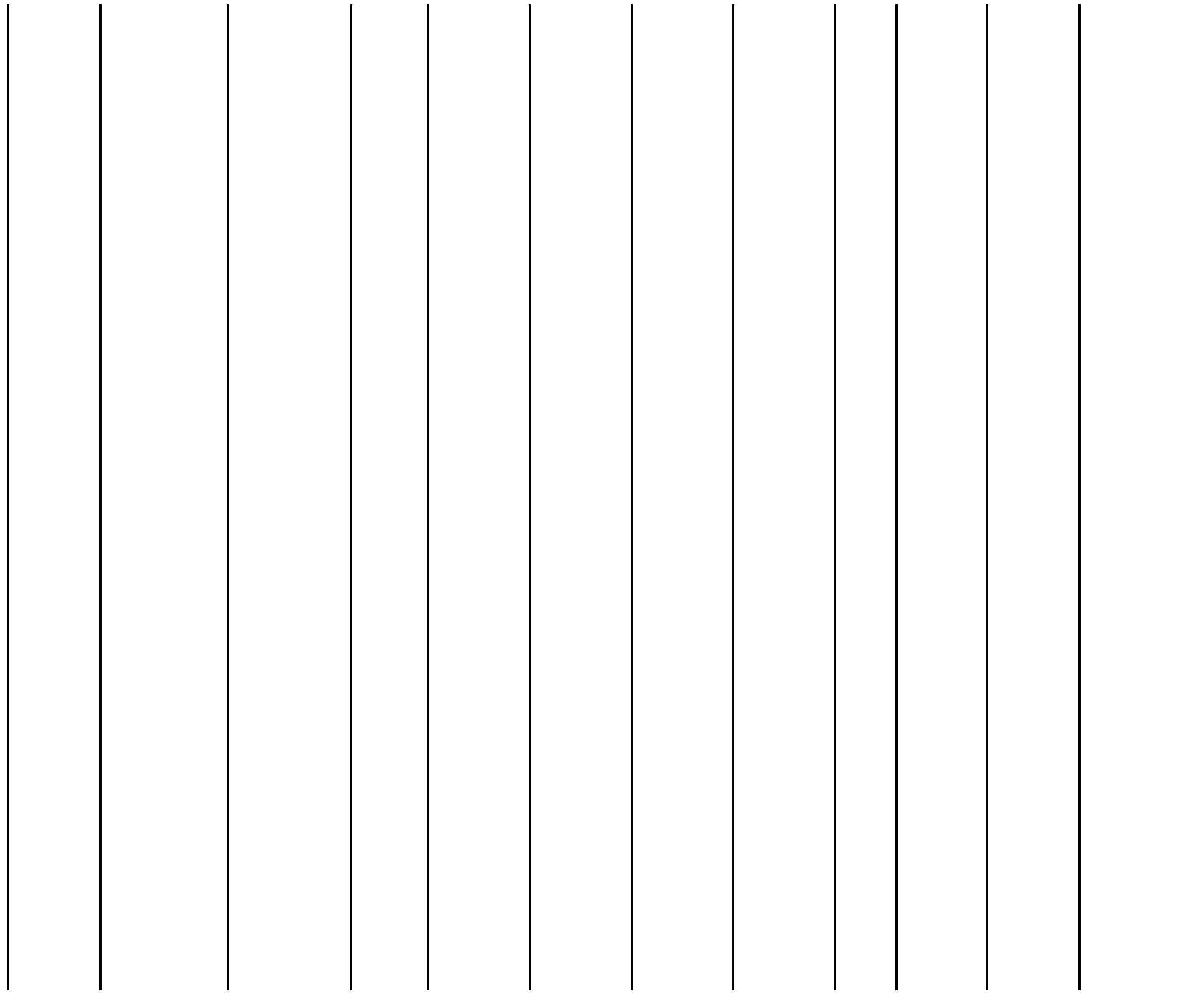
Appendix F:
Hydraulic Analysis

StormCAD Analysis



Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)
Link-01	CB 14	DMH 12	57.61	251.00	249.50	2.6000	12.000	0.12	2.95	4.98	0.02	0.11
Link-02	OCS 3	DMH 12	129.78	249.90	248.60	1.0000	12.000	0.53	3.03	3.09	0.17	0.28
Link-03	TD-1	DMH 2	70.57	251.50	250.30	1.7000	12.000	0.04	2.54	4.03	0.01	0.07
Link-04	DMH 1	DMH 2	85.33	251.00	250.20	0.9400	18.000	5.28	6.19	8.81	0.60	0.83
Link-05	DMH 2	DMH 3	108.22	250.20	249.30	0.8300	18.000	5.25	5.93	8.30	0.63	0.86
Link-06	DMH 3	DMH 4	103.78	249.20	248.60	0.5800	18.000	5.25	5.02	6.92	0.76	0.97
Link-07	WQU	DMH 3	12.32	252.00	251.50	4.0600	12.000	0.12	3.09	6.22	0.02	0.10
Link-09	CB 1	DMH 11	59.22	251.70	251.10	1.0100	12.000	0.17	2.45	3.11	0.06	0.16
Link-10	CB 2	DMH 11	9.78	251.80	251.70	1.0200	12.000	0.06	1.58	3.12	0.02	0.10
Link-11	DMH 11	DMH 5	43.43	251.10	250.60	1.1500	12.000	0.23	2.45	3.31	0.07	0.18
Link-12	CB 3	DMH 5	29.66	251.60	251.40	0.6700	12.000	0.04	1.50	2.54	0.01	0.08
Link-13	DMH 5	WQU 1	48.57	250.50	250.00	1.0300	12.000	0.27	2.46	3.13	0.09	0.20
Link-14	WQU 1	DMH 6	57.86	249.90	249.30	1.0400	12.000	0.26	2.46	3.14	0.08	0.20
Link-15	CB 5	DMH 6	20.12	251.30	251.10	0.9900	12.000	0.15	2.05	3.08	0.05	0.15
Link-16	DCB 4	DMH 6	35.98	251.30	250.90	1.1100	12.000	0.27	2.54	3.26	0.08	0.20
Link-18	CB 7	DMH 8	53.46	234.00	231.50	4.6800	12.000	0.10	4.39	7.31	0.01	0.08
Link-19	DCB 6	DMH 8	68.99	232.10	231.30	1.1600	12.000	0.32	2.93	3.72	0.09	0.20
Link-20	DMH 8	DMH 9	119.38	231.00	228.30	2.2600	12.000	0.41	4.14	5.44	0.08	0.19
Link-21	CB 11	DMH 9	79.09	231.00	228.30	3.4100	12.000	0.13	4.63	5.71	0.02	0.10
Link-22	DMH 9	DMH 10	24.58	228.20	228.00	0.8100	18.000	0.53	2.62	8.21	0.06	0.26
Link-23	CB-9	DMH 10	37.21	235.00	228.00	18.8100	12.000	0.22	6.34	13.39	0.02	0.09
Link-24	DCB 8	DMH 10	79.42	228.00	227.00	1.2600	15.000	0.56	4.80	6.28	0.09	0.25
Link-25	CB 10	DMH 10	36.39	227.20	225.70	4.1200	15.000	0.28	2.87	7.19	0.04	0.17
Link-27	CB 12	WQU 4	48.80	228.50	226.50	4.1000	18.000	0.18	4.14	18.43	0.01	0.11
Link-28	CB 13	WQU 4	28.45	227.50	225.50	7.0300	12.000	0.30	4.88	7.98	0.04	0.13
Link-30	CB 7	DCB 6	95.82	235.00	233.00	2.0900	18.000	0.01	1.76	20.80	0.00	0.03
Link-31	CB 11	CB-9	81.68	231.00	228.50	3.0600	18.000	0.02	2.26	27.40	0.00	0.03
Link-32	CB 12	CB 13	73.00	228.50	228.30	0.2700	18.000	0.03	2.17	22.60	0.00	0.04
Link-33	DCB 8	CB 10	83.14	228.00	227.00	1.2000	18.000	0.07	3.86	22.33	0.00	0.06
Link-34	Orifice 2	DMH 1	15.15	251.50	251.00	3.3000	18.000	5.35	8.46	16.54	0.32	0.60

Link-35	Orifice 4	Orifice 3	9.24	251.80	251.70	1.0800	12.000	2.12	5.98	3.21	0.66	0.59
Link-36	Orifice 3	Orifice 2	10.36	251.70	251.50	1.9300	12.000	3.92	6.31	4.29	0.91	0.77
Link-37	ORIFICE 7	OCS 3	29.65	251.50	252.20	-2.3600	6.000	0.52	2.90	0.75	0.69	0.43
Link-38	OCS 1	HW 1	29.30	0.00	225.50	-769.6200	24.000	14.33	9.78	30.30	0.47	0.97
Link-39	OCS 2	EX OUTFALL	22.34	247.15	246.70	2.0100	18.000	12.61	8.69	12.92	0.98	1.20



Appendix G: Erosion and Sedimentation Control Measures

Erosion and Sedimentation Control Measures

The following erosion and sedimentation controls are for use during the earthwork and construction phases of the project. The following controls are provided as recommendations for the site contractor and do not constitute or replace the final Stormwater Pollution Prevention Plan that must be fully implemented by the Contractor and owner in Compliance with EPA NPDES regulations.

Hay Bale Barriers

Hay bale barriers will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. Bales will be set at least four inches into the existing ground to minimize undercutting by runoff.

Silt Fencing

In areas where high runoff velocities or high sediment loads are expected, hay bale barriers will be backed up with silt fencing. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The silt fences and hay bale barrier will be replaced as determined by periodic field inspections.

Catch Basin Protection

Newly constructed and existing catch basins will be protected with hay bale barriers (where appropriate) or silt sacks throughout construction.

Gravel and Construction Entrance/Exit

A temporary crushed-stone construction entrance/ exit will be constructed. A cross slope will be placed in the entrance to direct runoff to a protected catch basin inlet or settling area. If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site.

Diversion Channels

Diversion channels will be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

Temporary Sediment Basins

Temporary sediment basins will be designed either as excavations or bermed stormwater detention structures (depending on grading) that will retain runoff for a sufficient period of time to allow suspended soil particles to settle out prior to discharge. These temporary basins will be located based on construction needs as determined by the contractor and outlet devices will be designed to control velocity and sediment. Points of discharge from sediment basins will be stabilized to minimize erosion.

Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.
- The on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained on-site by the contractor.
- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of hay bales should be kept in close contact with the earth and reset as necessary.
- Sediment that is collected in structures shall be disposed of properly and covered if stored on-site.
- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

Construction Best Management Practices - Maintenance/Evaluation Checklist

125 Pennsylvania Avenue, Framingham, Massachusetts
Construction Best Management Practices – Maintenance/ Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by:
Siltsock/Silt Fence Barrier	Weekly and after storm events				☐yes ☐no		
Gravel Construction Entrance	Weekly and after storm events				☐yes ☐no		
Catch Basin Protection	Weekly and after storm events				☐yes ☐no		
Diversion Channels	Weekly and after storm events				☐yes ☐no		
Temporary Sedimentation Basins	Weekly and after storm events				☐yes ☐no		
Vegetated Slope Stabilization	Weekly and after storm events				☐yes ☐no		
Stock Pile Protection	Daily and after storm events				☐yes ☐no		

Stormwater Control Manager ____

Appendix H:
Long Term Pollution Prevention Plan and Maintenance Measures

Long Term Pollution Prevention Plan

The following maintenance program is proposed to ensure the continued effectiveness of the structural water quality controls previously described.

- Clean all catch basins Four times per year to remove accumulated sand, sediment, and floatable products or as needed based on use.

- Paved areas will be swept, at a minimum, four times per year.

- Routinely pick up and remove litter from the Neponset River bank, parking areas, islands and perimeter landscape areas in addition to regular pavement sweeping.

- Routinely inspect all dumpster and compactor locations for spills. Remove all trash litter from the enclosure and dispose of properly.

Pavement Systems

Standard Asphalt Pavement

- Sweep or vacuum standard asphalt pavement areas at least four times per year with a commercial cleaning unit and properly dispose of removed material.
- Recommended sweeping schedule:
  - Oct/ Nov
  - Feb/ Mar
  - Apr/ May
  - Aug/ Sep
  - More frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.
- Check loading docks and dumpster areas frequently for spillage and/ or pavement staining and clean as necessary.

Structural Stormwater Management Devices

Catch Basins

- All catch basins shall be inspected and cleaned a minimum of at least four times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Structural Water Quality Devices

- Inspect devices monthly for the first three months after construction.
- After initial three month period, all water quality units are to be inspected at least four times per year and cleaned a minimum of at least once per year or when sediment reaches 8" in depth.
- Follow manufacturer instructions for inspection and cleaning and contact manufacturer if system is malfunctioning.

Roof Drain Leaders

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets draining to the subsurface bed twice per year as necessary.

Vegetated Stormwater Management Devices

Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.

- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- The grass vegetation should not be cut to a height less than four inches.
- Pesticide/ Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.

Spill Prevention and Response Plan

All construction personnel will be instructed regarding spill prevention practices and procedures. Notices stating these practices will be posted in the office trailer, and the site construction supervisor will be responsible for seeing that these procedures are followed. Refer to Appendix I for Spill Response Procedure.

Material Management Practices

The following material management practices will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff. These include good housekeeping practices and guidelines for the handling of hazardous products.

The following good housekeeping practices will be followed on-site during the construction period.

- An effort will be made to store only enough products required to do the job.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers, and (if possible) under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect the storage area daily to ensure proper use and disposal of materials on-site.

The following practices will reduce the risks associated with hazardous materials (e.g., petroleum products, solvents).

- A copy of all Material Safety Data Sheets (MSDS) for materials or products used during construction will be kept in the office trailer.
- Products will be kept in original containers unless they are not re-sealable.
- Original labels and material safety data (MSD sheets) will be retained; they contain important product information.
- If surplus product must be disposed, manufacturer's or local- and state-recommended methods for proper disposal will be followed.

Product-Specific Practices

The following product-specific practices will be followed on-site. Recommendations are provided for petroleum products, solvents, paints, and other hazardous substances, and concrete.

Petroleum Products and Hydraulic fluids

All mechanized equipment present on-site that use hydraulic systems will be inspected on a daily basis for leaks by the contractor. Leaks will be identified and repaired as necessary to prevent uncontrolled release of these petroleum based materials. No vehicle maintenance or handling of petroleum products will occur within 100 feet of a wetland or waterway. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used on-site will be applied according to manufacturer's recommendations. The contractor will maintain two complete spill prevention kits on site. All refueling activities will be attended at all times. No unattended refueling will be permitted at any time. Any equipment requiring repair shall be worked on outside of the resource are and the buffer zone. This includes the entire Russia Wharf deck area.

Solvents, Paints, and other Hazardous Substances

All containers will be tightly sealed and stored when not required for use. Excess materials will not be discharged to the storm sewer system, but will be properly disposed according to manufacturer's instructions or state and local regulations. No storage will occur within 100 feet of a wetland or waterway.

Concrete Trucks

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water within 100 feet of wetland resources or into catch basins that are already in place.

Hazardous Material Spill

Due to the nature of the project, it is not anticipated that large amounts of chemicals or gasses will be encountered during demolition or construction. As with any construction, the contractor is responsible to require the use and handling of limited quantities of petroleum products and other hazardous materials. The spill prevention plan is intended to describe the methods for monitoring the use of these materials and containment and cleanup in the event of an inadvertent release. The principal hazardous materials anticipated to be present at the site are petroleum based fuels and hydraulic fluids for construction equipment and contaminated soils that may be present beneath the existing buildings.

Contaminated Soils

Presently, the contractor is in the process of completing testing of subsurface conditions to ascertain the presence and characteristics of any contaminated soils or sediment present at the site. The removal, control and disposal of any such materials would be subject to jurisdiction of the Massachusetts Contingency Plan. The handling and control of these materials would be the subject of a report filed by the project's Licensed Site Professional under the MCP. A copy of this will be provided to the Boston Conservation Commission as may be required.

Small Spills

Spills of materials of relatively low hazard (non-life threatening) like fuel, oil etc. and quantity of less than 10 gallons will be cleaned up and properly disposed of by the contractor as directed by the Boston Conservation Commission's Order of Conditions. Any waste manifest (s) will be retained on file and provided to all appropriate parties by the contractor.

Larger/High Hazard Spills

In the event of a spill larger than 10 gallons (or high hazard chemical spill), the onsite supervisor will immediately contact the Boston Fire Department. The contractor will isolate the spill, if safe to do so, and prevent unauthorized individuals from entering the area. As soon as reasonably possible, the contractor will contact the appropriate Safety Representative or designee and report then spill. All spills will be cleaned up and disposed of, by the contractor, as directed by the Boston Conservation Commissions Order of Conditions. Recovered spill material and cleaning products will be placed in a container and disposed of properly. Any waste manifest (s) will be retained on file and submitted to all appropriate parties, by the contractor.

In the case where a spill or accident may be discharged to the Neponset River or any catch basin tributary to the Neponset River and thereby impact wetland resource area; the Boston Conservation will be notified by the contractor. As part of the environmental protection measures of the project a floating boom will be installed outside the seawall at the commencement of construction, by the contractor, to minimize any impacts to the quality of water in the case of a spill.

Spill Control/Notification Practices

In addition to the good housekeeping and material management practices discussed above, the following practices will be followed for spill control, notification and cleanup.

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be informed of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but will not be limited to, shovels, wheel barrows, brooms, dust pans, mops, rags, gloves, goggles, kitty litter or Speedi-Dry, sand, sawdust, and plastic and metal trash containers specifically designated for this purpose.
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material in excess of reportable quantities, as established in the Massachusetts Contingency Plan (MCP), will be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste [(617) 292-5851 or (978) 661-7679]. The Emergency Spill Response Procedure is provided on page 28.
- The onsite supervisor is responsible for the daily operations will be the spill prevention and cleanup coordinator. He will designate at least three other site personnel to receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of the responsible spill personnel will be posted in the material storage area and in the on-site office trailer.

Source Control

Trash removal, designated trash storage areas, pavement sweeping and the controlled use of fertilizer and deicing agents on the site will reduce the pollutant load in the site's stormwater management system.

Construction Trash Removal

Daily loose trash removal will prevent litter, construction debris, and construction chemicals exposed to stormwater from becoming a pollutant source for stormwater discharges. All loose trash will be placed in appropriate storage containers until disposed of properly off-site.

Covered Trash/Storage Areas

Areas to be used for storing dumpsters, compactors or other raw or waste materials will be covered to prevent contact with stormwater.

Pavement Sweeping

Pavement sweeping may be required daily or even more frequently during construction where sediment tracking from construction equipment is a problem. The sweeping program will remove sediments and contaminants directly from paved surfaces before their release into stormwater runoff. Pavement sweeping has been demonstrated to be an effective initial treatment for reducing pollutant loading into stormwater[1].

Fertilizer

Only slow-release organic fertilizers will be used in landscaped areas. This will limit the amount of nutrients that could enter the stormwater and wetland systems. Fertilizer use will be reduced once the proposed landscaping is established.

Waste Disposal

All waste materials will be collected and stored in securely lidded metal dumpsters leased from a licensed solid waste management company and the dumpster will be emptied as necessary. Trash will be hauled by a licensed contractor and disposed in accordance with federal, state, and local environmental regulations. No trash or construction waste will be buried on-site, and all personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer and the site construction supervisor will be responsible for seeing that these procedures are followed.

Hazardous Waste

All hazardous waste materials (e.g., petroleum products, solvents) will be disposed in the manner specified by local and state regulation, or by the manufacturer. Site personnel will be instructed in these practices, and the site construction supervisor will be responsible for seeing that these procedures are followed.

▼

[1] U.S. Environmental Protection Agency, 1979. *Demonstration of Nonpoint Pollution Abatement Through Improved Street Cleaning Practices.*

Sanitary Waste

All sanitary waste will be collected from the portable units by a licensed contractor a minimum of three times weekly, and disposed in compliance with state and local regulation.

Long Term Best Management Practices Checklist

125 Pennsylvania Avenue, Framingham, Massachusetts

Long Term Best Management Practices – Maintenance/ Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Water Quality Unit	Quarterly				☐yes ☐no		
Deep Sump and Hooded Catch basin	Quarterly				☐yes ☐no		
Street Sweeping	Quarterly				☐yes ☐no		
Inspect Outfall Structure	Twice a Year				☐yes ☐no		
Bio-Retention Basin Mowing, Inspect & Trash Removal	Monthly				☐yes ☐no		
Bio-Retention Basin Mulch	Annually				☐yes ☐no		
Bio-Retention Basin Fertilize	Annually				☐yes ☐no		
Bio-Retention Basin Removal of Dead Vegetation	Annually				☐yes ☐no		
Bio-Retention Basin Prune	Annually				☐yes ☐no		
Underground Retention System	Quarterly				☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		

Stormwater Control Manager ______________________________

Appendix I:
Spill Prevention & Response

Spill Response Procedure

Initial Notification

In the event of a spill the facility and/or construction manager or supervisor will be notified immediately.

Facility Manager (name) ____________________

Facility Manager (phone) ____________________

Construction Manager (name) ____________________

Construction Manager (phone) ____________________

Assessment - Initial Containment

The supervisor or manager will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. The supervisor will first contact the Fire Department and then notify the Police Department, Board of Health and Conservation Commission. The fire department is ultimately responsible for matters of public health and safety and should be notified immediately.

Fire Department Phone: 911
781-397-7383

Police Department: 911
781-397-7171

Board of Health Phone: 781-397-7053

Conservation Commission Phone: 781-397-7040

Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the main construction/facility office and readily accessible to all employees.

HAZARDOUS WASTE / OIL SPILL REPORT

Date____/_____/_____ Time____________ AM / PM

Exact location (Transformer #)____

Type of equipment___________________________Make_____________Size_______________

S / N_________________________________Weather Conditions________________________

On or near water ☐ Yes If yes, name of body of water_____________________

☐ No

Type of chemical / oil spilled__________________________

Amount of chemical / oil spilled________________________

Cause of spill____

____

____

Measures taken to contain or clean up spill____

____

____

Amount of chemical / oil recovered________________Method____________________________

Material collected as a result of clean up

_____________drums containing____

_____________drums containing____

_____________drums containing____

Location and method of debris disposal____

____

Name and address of any person, firm, or corporation suffering damages____________________

____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring___

____

Spill reported to General Office by__________________________Time_____________AM / PM

Spill reported to DEP / National Response Center by____________________________________

DEP Date____/_____/_____ Time_________ AM / PM Inspector________________

NRC Date____/_____/_____ Time_________ AM / PM Inspector________________

Additional comments____

____

____

**EMERGENCY RESPONSE EQUIPMENT
INVENTORY**

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

--	SORBENT PADS	2 BALES
--	SORBENT BOOM	100 FEET
--	SAND BAGS (empty)	50
--	SEWER PIPE PLUGS	
	-- 12 INCH DIAM.	1
--	SPEEDI-DRI ABSORBENT	5 40# BAGS
--	SQUARE END SHOVELS	1
--	PICK	1
--	PRY BAR	1
--	DRAIN COVERS	2

EMERGENCY NOTIFICATION PHONE NUMBERS

1. SUPERVISOR/MANAGER
   NAME: ____________________ BEEPER: ____________________
   PHONE: ____________________ HOME PHONE: ____________________

   ALTERNATE:
   NAME: ____________________ BEEPER: ____________________
   PHONE: ____________________ HOME PHONE: ____________________

2. FIRE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 397-7383

   POLICE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 397-7171

3. CLEANUP CONTRACTOR: ____________________
   ADDRESS: ____________________
   PHONE: ____________________

4. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
   EMERGENCY: (617) 556-1133
   NORTHEAST REGION - WOBURN OFFICE: (617) 932-7600

5. NATIONAL RESPONSE CENTER
   PHONE: (800) 424-8802

   ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY
   EMERGENCY: (617) 223-7265
   BUSINESS: (617) 860-4300

6. CONSERVATION COMMISSION
   CONTACT: (781) 397-7040

   BOARD OF HEALTH
   CONTACT: (781) 397-7053

7. FACILITY MANAGER
   NAME: ____________________
   PHONE: ____________________

Appendix J:
Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

---

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- [x] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [x] Minimizing disturbance to existing trees and shrubs
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] Credit 3
- [x] Use of "country drainage" versus curb and gutter conveyance and pipe
- [x] Bioretention Cells (includes Rain Gardens)
- [ ] Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- [ ] Treebox Filter
- [ ] Water Quality Swale
- [ ] Grass Channel
- [ ] Green Roof
- [x] Other (describe): RECHARGE GALLEYS, STORMCEPTOR, IRRIGATION TANK FROM ROOF TOP RUNOFF

Standard 1: No New Untreated Discharges

- [x] No new untreated discharges
- [x] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [x] Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

- [ ] Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- [ ] Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- [x] Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- [ ] Soil Analysis provided.
- [ ] Required Recharge Volume calculation provided.
- [ ] Required Recharge volume reduced through use of the LID site Design Credits.
- [ ] Sizing the infiltration, BMPs is based on the following method: Check the method used.

  [x] Static [ ] Simple Dynamic [ ] Dynamic Field[1]

- [x] Runoff from all impervious areas at the site discharging to the infiltration BMP.
- [ ] Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- [x] Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- [ ] Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - [ ] Site is comprised solely of C and D soils and/or bedrock at the land surface
  - [ ] M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - [ ] Solid Waste Landfill pursuant to 310 CMR 19.000
  - [ ] Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- [x] Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- [ ] Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist (continued)

Standard 3: Recharge (continued)

- [x] The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- [x] Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

- [x] A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- [ ] Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
  - [ ] is within the Zone II or Interim Wellhead Protection Area
  - [ ] is near or to other critical areas
  - [ ] is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
  - [ ] involves runoff from land uses with higher potential pollutant loads.
- [ ] The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- [x] Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- [x] The BMP is sized (and calculations provided) based on:
  - [x] The ½" or 1" Water Quality Volume or
  - [x] The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- [x] The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- [ ] A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- [ ] The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- [x] The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.
- [ ] The NPDES Multi-Sector General Permit does ***not*** cover the land use.
- [x] LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- [ ] All exposure has been eliminated.
- [ ] All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- [ ] The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- [ ] The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- [ ] Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- [x] The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

- [ ] The project is ***not*** covered by a NPDES Construction General Permit.
- [ ] The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- [x] The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- [x] The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - [x] Name of the stormwater management system owners;
  - [x] Party responsible for operation and maintenance;
  - [x] Schedule for implementation of routine and non-routine maintenance tasks;
  - [x] Plan showing the location of all stormwater BMPs maintenance access areas;
  - [x] Description and delineation of public safety features;
  - [ ] Estimated operation and maintenance budget; and
  - [x] Operation and Maintenance Log Form.
- [ ] The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - [ ] A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - [ ] A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- [x] The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- [ ] An Illicit Discharge Compliance Statement is attached;
- [ ] NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix K: Water Quality Volume, Recharge Volume, and Drawdown Calculations